POLARAD

PROVEN RELIABILITY

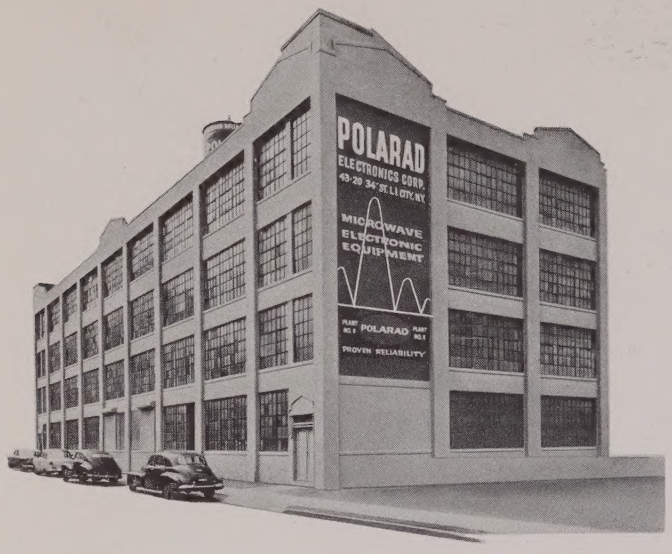
HANDBOOK
OF
OPERATING INSTRUCTIONS

POLARAD MODEL R
MICROWAVE RECEIVER

(400Mc to 46,700Mc)

QC CAL/CERT
PROCEDURES
GROUP COPY 2-4880
38-16
DONALD LEVETON

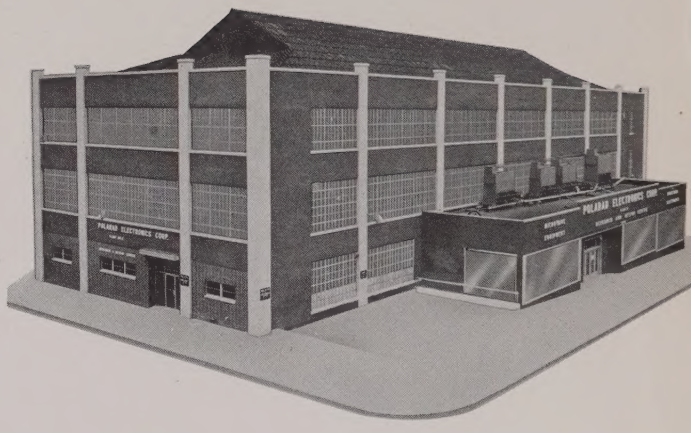
POLARAD ELECTRONICS CORPORATION, 43-20 34th STREET, LONG ISLAND CITY 1, N.Y.



PLANT 1

**ENGINEERING &
ADMINISTRATIVE OFFICES**

43-20 34th STREET
LONG ISLAND CITY, NEW YORK
EXETER 2-4500



PLANT 2

**RESEARCH & DESIGN
CENTER**

33-10 QUEENS BLVD.
**LONG ISLAND CITY,
NEW YORK**

PLANT 4

**PRODUCTION ENGINEERING
& FACTORY
34-02 QUEENS BLVD.
LONG ISLAND CITY, NEW YORK**

**PERSONNEL RECRUITMENT
& WAREHOUSE
43-15 34th STREET
LONG ISLAND CITY, NEW YORK**

PLANT 3

POLARAD ELECTRONICS CORPORATION 43-20 34th STREET, LONG ISLAND CITY 1, N. Y.

POLARAD

PROVEN RELIABILITY

INSTRUCTION MANUAL

POLARAD MODEL R

MICROWAVE RECEIVER

(400Mc to 46,700Mc)

SERIAL NOS. 1352 TO 1602

QC CAL/CERT
PROCEDURES
GROUP COPY

POLARAD ELECTRONICS CORPORATION • 43-20 34th St., Long Island City 1, N. Y.

© Polarad Electronics Corporation, 1961

Warranty

Polarad Electronics Corporation warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, fuses or batteries, which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which on our examination shall disclose to our satisfaction to have been thus defective.

Polarad Electronics Corporation reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of the Polarad Electronics Corporation, and Polarad neither assumes nor authorizes any other person to assume for them any other liability in connection with the Sales of Polarad's instruments.

POLARAD
PROVEN RELIABILITY

TABLE OF CONTENTS

THE POLARAD MODEL R MICROWAVE RECEIVER,

Part I - BASIC INSTRUMENT

Paragraph		Page
	SECTION I -- GENERAL DESCRIPTION	
1.	Introduction	1
2.	Purposes of the Equipment	1
3.	Physical Description of Equipment	2
4.	Electrical Characteristics	3
5.	Electron Tube, Fuse and Lamp Complement	5
	SECTION II -- THEORY OF OPERATION	
1.	General System Operation	6
2.	Tuning Unit, System Operation	8
3.	Local Oscillator Sub-Chassis	8
4.	IF Amplifier	8
5.	FM Amplifier	9
6.	Detected Signal Amplifier	10
7.	Front Panel Controls	11
8.	Klystron Power Supply	11
9.	Low Voltage Power Supply	12
	SECTION III -- INSTALLATION AND OPERATION	
1.	Installation	15
2.	Checking Inter-Cabling Connections	15
3.	Operating Controls	17
4.	Indicators	21
5.	Preliminary Operating Procedure	22
6.	Input Signal Characteristics	23
7.	Calibrate Gain	23
8.	Specific Applications	24
9.	CW Signals	24
10.	Pulse Modulated Signals	24
11.	AM Signals	24
12.	FM Signals	25
13.	Weak Signals	25
14.	Use of an External Attenuator	25
15.	Automatic Frequency Control	25
16.	Use of Recorder	26
17.	Measuring Model R Sensitivity	26
	SECTION IV -- MAINTENANCE AND ALIGNMENT PROCEDURES	
1.	General	27
2.	Troubleshooting	27
3.	Adjustments	29
4.	Power Supply Adjustments	30
5.	Local Oscillator Alignment	31
6.	IF Amplifier Alignment	32
7.	FM Amplifier Alignment	33
8.	Calibration of the 70 DB Meter Scale	37
9.	Calibration of the 30 DB Meter Scale	37
10.	AFC Circuit Adjustment	38
11.	Voltage Measurements	38A

Part II - R.F. TUNING HEADS

Paragraph		Page
	SECTION V -- GENERAL DESCRIPTION	
1.	Introduction	53
2.	Electron Tube Complement	53
	SECTION VI -- THEORY OF OPERATION	
1.	General	55
2.	RF Preselector, Detailed Description	56
3.	Crystal Mixer, Detailed Description	56
4.	First Local Oscillator, Detailed Description	58
5.	Protective Diode, Detailed Description	60
	SECTION VII -- INSTALLATION AND OPERATION	
1.	General	62
2.	Waveguide Adapters	62
3.	Installation	63
4.	Operating Control	63
5.	Operation	63
	SECTION VIII -- MAINTENANCE AND ALIGNMENT PROCEDURES	
1.	General	65
2.	Troubleshooting	65
3.	First Local Oscillator, Tube Replacement and Bias Setting	66
4.	RF Oscillator Calibration Procedure	75
5.	Preselector Adjustments	78
6.	Crystal Mixer	79
7.	Preamplifier Filter	79
8.	Preamplifier	81

LIST OF ILLUSTRATIONS

THE POLARAD MODEL R MICROWAVE RECEIVER

Figure	Title	Page
1-1	The Polarad Model R Microwave Receiver	iv
2-1	A Typical Tuning Unit, Functional Block Diagram	7
3-1	Inter-Unit Cabling Diagram	13/14
3-2	The Polarad Model R Microwave Receiver, Operating Controls	18
4-1	Local Oscillator Chassis, Top View	31
4-2	IF Amplifier Chassis, Top View	32
4-3	FM Amplifier Chassis, Top View	34
4-4	Detected Signal Amplifier Chassis, Top View	36
4-5	Model R Microwave Receiver, Functional Block Diagram	39/40
4-6	Local Oscillator, Schematic Diagram	41/42
4-7	IF Amplifier, Schematic Diagram	43/44
4-8	FM Amplifier, Schematic Diagram	45/46
4-9	Detected Signal Amplifier, Schematic Diagram	47/48
4-10	Main Chassis, Schematic Diagram	49/50
5-1	A Typical RF Tuning Unit, Partially Withdrawn from Cabinet	52
6-1	RKS-T and RKU-T Tuning Heads, Block Diagram	54
6-2	Model RQ-T RF Tuning Unit, Block Diagram	57
8-1	Typical Tuning Unit, Right Rear View	66
8-2	Typical Tuning Unit, Left Rear View	67
8-3	Model RQ-T RF Tuning Unit, Right Rear View	69
8-4	Model RQ-T RF Tuning Unit, Left Rear View	70
8-5	Test Set-Up for Tracking Mode Patterns	72
8-6	Oscillator Adjustable Tuning Cam	76
8-7	Preamplifier Filter Chassis, Top View	80
8-8	Preamplifier Chassis, Top View	82
8-9	Model RR-T Tuning Unit, Schematic Diagram	83/84
8-10	Model RL-T Tuning Unit, Schematic Diagram	85/86
8-11	Model RS-T Tuning Unit, Schematic Diagram	87/88
8-12	Model RM-T Tuning Unit, Schematic Diagram	89/90
8-13	Model RX-T Tuning Unit, Schematic Diagram	91/92
8-14	Model RKS-T Tuning Unit, Schematic Diagram	93/94
8-15	Model RKU-T Tuning Unit, Schematic Diagram	95/96
8-16	Model RQ-T Tuning Unit, Schematic Diagram	97/98

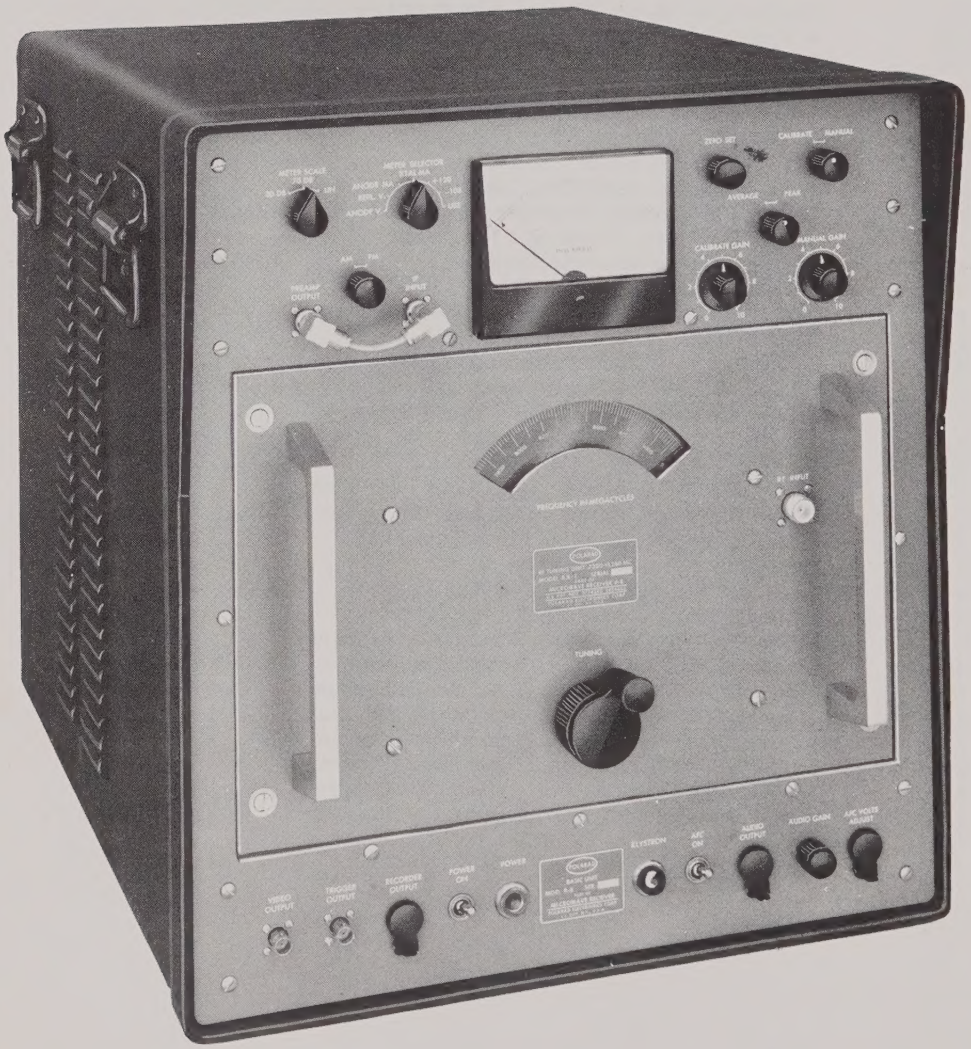


FIGURE 1-1. THE POLARAD MODEL R MICROWAVE RECEIVER

SECTION I

GENERAL DESCRIPTION

1. INTRODUCTION

a. The Polarad Model R Microwave Receiver is a laboratory and field test instrument operating from 400 to 46,700 mc. Eight Tuning Units are used to cover this frequency range. The receiver is housed in an aluminum dust cover, having facilities for replacing the R-F Tuning Unit directly from the front panel.

b. This manual consists of two parts. Part I covers the operation of the entire unit. The maintenance of the Basic Unit is covered in Part I, while Part II covers the RF Tuning Units.

c. The frequency ranges of the replaceable Tuning Units available for use with the basic instrument are listed below:

Model No.	Frequency Range
RR-T	400 - 1,000 mc.
RL-T	950 - 2,040 mc.
RS-T	1,900 - 4,340 mc.
RM-T	4,200 - 7,740 mc.
RX-T	7,300 - 11,260 mc.
RKS-T	9,500 - 15,600 mc.
RKU-T	14,700 - 22,000 mc.
RQ-T	20,300 - 46,700 mc.

d. When additional Tuning Units are made available, supplementary parts to this manual will be issued.

2. PURPOSES OF THE EQUIPMENT

a. The Model R Microwave Receiver is a versatile test instrument, providing broad frequency coverage by means of its easily interchangeable Tuning Units. It permits absolute or comparative power and frequency measurements, by means of its panel-mounted meter, or virtually every type of signal found in microwave work. In addition, it provides audio, video, and recorder outputs for monitoring of these signals.

b. Specific applications of the equipment are its use as a:

(1) Broadband receiver for reception of continuous wave (CW), frequency modulated (FM), amplitude modulated (AM), and pulse-modulated signals;

(2) Field intensity meter;

(3) Measurement instrument for r-f leakage and interference tests;

(4) Means of measuring relative power of a fundamental signal frequency, and its harmonics;

(5) Means of measuring the bandwidth of microwave cavities;

(6) Frequency meter;

(7) Trigger-pulse amplifier. The equipment produces a video trigger signal of 10 volts amplitude across 100 ohms, from the reception and detection of pulsed CW signals;

(8) Means of measuring noise figure of RF amplifiers;

(9) Means of measuring and calibrating the rate of attenuation of attenuators down to minus 70 dbm.

3. PHYSICAL DESCRIPTION OF EQUIPMENT (See figure 1-1)

a. The equipment is supplied in a wrap-around aluminum green-finish dust cover. Overall dimensions are approximately 17 inches wide by 19 inches high by 23 inches deep. Its weight is approximately 170 pounds. The sides of the case are louvered for ventilation, and are provided with two carrying handles on each side.

b. Four sub-chassis, consisting of the IF Amplifier, the Local Oscillator, the FM Amplifier and the Detected Signal Amplifier, are mounted to the top deck of the main chassis. All leads are brought out to connectors, to simplify disassembly. The power supplies, with their heavy components, are located on the main chassis floor. The blower, which provides ventilation for the receiver, is mounted at the top rear of the chassis.

c. A detailed physical description of each Tuning Unit is found in the applicable part of this manual. Four captive fasteners, located at the corners of the Tuning Unit front panel, retain the unit in the equipment cabinet. The slide mounted Tuning Units are easily replaced by loosening the four captive fasteners and withdrawing the Tuning Unit from the front of the cabinet. Pulling the Tuning Unit straight out from the cabinet permits access to the cable harness, which applies power and signal cables to the multi-pin connector mounted on the side of the Tuning Unit. The coaxial cables which terminate at jacks on the Tuning Unit also have sufficient slack to permit partial withdrawal of the unit from the cabinet. After disconnecting power and coaxial cables from their mating receptacles, the Tuning Unit may be removed completely and a different Tuning Unit, covering the desired frequency range, may be inserted within the cabinet. Voltage switching for each tuning head is accomplished by the multi-pin connector.

d. The power input receptacle and fuses are mounted at the rear of the chassis. The 115-230 volt switch is mounted on the lower right hand corner of the right side frame, and is accessible only when the receiver is removed from its dust cover. Signal cable connections, operating controls, and all indicator lamps are mounted on the front panel. A one-milliampere d-c meter, provided with four scale calibrations, serves the following functions:

(1) Two scales are used as a basic indicator for measuring signal strength;
(2) A third scale is used to monitor crystal current, or as a linear scale;
(3) The fourth scale is used for checking the voltage outputs of the self-contained power supplies.

e. Signal monitoring provisions include the following front panel jacks:

(1) AUDIO OUTPUT receptacle, for headset monitoring;
(2) VIDEO OUTPUT receptacle, for observing signal waveforms;
(3) RECORDER OUTPUT receptacle, for graphic recording of meter readings by applying the Model R Receiver output to a recorder, equivalent to the Varian Model G11 100 mv. span;
(4) TRIGGER OUTPUT receptacle, for triggering external equipment with a 10-volt pulse, when pulse modulated signals are applied to the input of the receiver.

f. All required accessory cables are provided with the equipment. The equipment is shipped ready for operation, with tubes, fuses and indicators in place. Table 1-1 lists Tuning Units available, one or more of which may be purchased with a basic instrument. The accessory cables are supplied with the basic instrument. Table 1-2 shows electrical characteristics of the equipment. Table 1-3 gives the tube complement. Table 1-4 lists the fuse and lamp complement.

TABLE 1-1. EQUIPMENTS AND ACCESSORIES AVAILABLE

Polarad Model No.	Item	Function
R	Basic Instrument	Serves to mount the self-contained power supplies and the meter circuitry; has provision to mount replaceable sub-chassis and Tuning Unit.
RR-T	Tuning Unit	Replaceable Tuning Unit covering 400 - 1000 mc.
RL-T	Tuning Unit	Replaceable Tuning Unit covering 950 - 2040 mc.
RS-T	Tuning Unit	Replaceable Tuning Unit covering 1900 - 4340 mc.
RM-T	Tuning Unit	Replaceable Tuning Unit covering 4200 - 7740 mc.
RX-T	Tuning Unit	Replaceable Tuning Unit covering 7300 - 11,260 mc.
RKS-T	Tuning Unit	Replaceable Tuning Unit covering 9500 - 15,600 mc.
RKU-T	Tuning Unit	Replaceable Tuning Unit covering 14,700-22,000 mc.
RQ-T	Tuning Unit	Replaceable Tuning Unit covering 20,300 - 46,700 mc.
W115	Power Cable	Applies operating power to power input receptacle J105, at the rear of the cabinet.
*W103	IF Input Cable	An RG-55/U cable which connects the input signal from the front panel PREAMP OUTPUT to the IF INPUT jack.
	Video Cable	Connects to either the VIDEO OUTPUT jack, or the TRIGGER OUTPUT (triggering pulse output) jack, on the front panel.

*This cable may be replaced by an external IF attenuator, for relative amplitude measurements of input signals.

4. ELECTRICAL CHARACTERISTICS

The Model R Microwave Receiver is a precision measuring device. Frequency stability is maintained at ±0.25% after a ten-minute warm-up period for any line voltage variation at 115 or 230 volts operation (±10%). All voltage supplies, including the filament supplies to the preamplifier, to the IF amplifier, and to the meter circuit, are electronically regulated.

TABLE 1-2. ELECTRICAL CHARACTERISTICS

Frequency Range . . . . . 400 to 46,700 mc in eight Tuning Units:

(1) Model RR-T . . . 400 - 1000 mc;	(5) Model RX-T . . . 7300 - 11,260 mc;
(2) Model RL-T . . . 950 - 2040 mc;	(6) Model RKS-T . . . 9500 - 15,600 mc;
(3) Model RS-T . . . 1900 - 4340 mc;	(7) Model RKU-T . . . 14,700 - 22,000 mc;
(4) Model RM-T . . . 4200 - 7740 mc;	(8) Model RQ-T . . . 20,300-46,700 mc

Frequency Accuracy . . . . . ± 1% of direct dial reading.
Input Impedance . . . . . 50 ohms nominal;VSWR less than 4:1 over the band.
Bandwidth . . . . . 3 mc nominal, between 3 db points.
Image Rejection . . . . . 60 db.

TABLE 1-2. ELECTRICAL CHARACTERISTICS (cont)

Types of Signal Accepted	Continuous Wave (CW), Amplitude Modulated (AM), Frequency Modulated (FM), Pulse Modulated.
Acceptable Signal Input Amplitude	0.1 volt r-m-s (maximum), without external attenuation.
Intermediate Frequencies	First IF: 260 mc Second IF: 140 mc Third IF: 40 mc
Gain Stability	Better than ± 2 db.
Automatic Gain Control	Automatic gain control is operative with the METER SCALE switch in the 30 db or 70 db positions.
Automatic Frequency Control	Pull out range ± 10 mc off center.
Sensitivity	Minus 80 dbm.
Meter Characteristics:	
Movement	1 ma movement.
Response Time	275 ± 75 millisecond.
Damping	1 - 6% overshoot.
Scales	linear, 30 db, 70 db, and internal supply monitoring scales.
Recorder Output Characteristics	Output for a 100 mv recorder.
Video Characteristics:	
Output Impedance	100 ohms nominal.
Trigger Pulse Output	10 volts peak-to-peak.
Video Response	20 cps to 1.5 mc, flat within 2 db.
Audio Characteristics:	
Output Impedance	500 ohms.
Output Power	50 milliwatts.
Frequency Response	40-5000 cps.
FM Characteristics (through IF Amplifier):	
Bandwidth	3 mc.
Deviation	1-1/2 mc.
Power Requirements:	
Voltage	115 or 230 volts, single phase.
Power	460 watts.
Frequency	60 cps (50 cps available when specified).
Power Supply Characteristics:	
Reflector Supply	Minus 600 volts referenced below the anode voltage on all Tuning Units.

TABLE 1-2. ELECTRICAL CHARACTERISTICS (cont)

Anode Supply	Minus 325 volts with the Model RR-T, RL-T or RS-T Tuning Unit connected to the receiver. Delayed 60 seconds after the application of reflector voltage.
	Minus 1250 volts with the Model RM-T, RX-T, RKS-T, or RKU-T Tuning Unit connected to the receiver. Delayed 60 seconds after the application of reflector voltage.
	Minus 700 volts with Model RQ-T Tuning Unit connected to the receiver. Delayed 60 seconds after application of reflector voltage.
B Plus Supply	Plus 120 volts, electronically regulated.
Bias Supply	Minus 108 volts, gas diode regulated.

5. ELECTRON TUBE, FUSE AND LAMP COMPLEMENT

Table 1-3 below lists electron tubes, by subassembly, in the basic instrument of the Model R Microwave Receiver. The table of components for electron tubes and crystals used in each of the Tuning Units is listed in the Tuning Unit section of this handbook. The fuse and lamp complement is found in Table 1-4.

TABLE 1-3. ELECTRON TUBE COMPLEMENT

Subassembly	Tube Type	No. Required
Low Voltage Power Supply	OB2	1
	5R4GY	2
	6AS7	2
	6AU6	1
	6X4	1
High Voltage Power Supply	0A2	2
	5R4GY	3
	6AH6	1
	6AR6	1
	6AU6	2
	807	1
IF Amplifier	6AK5	8
	6AL5	1
	6AN5	1
	12AU7	2
Local Oscillator Circuits	6AK5	3
	12AT7	1
FM Amplifier	6AH6	2
	6AK5	2
	6AU6	4
	12AT7	1
Detected Signal Amplifier	6AS5	1
	6AU5	1
	6CL6	1
	6U8	1
	12AT7	2
	12AX7	1

TABLE 1-4. FUSE AND LAMP COMPLEMENT

Type	Number	Location
Fuses.	4 (2 spares)	Rear of chassis, accessible from rear of cabinet for replacement.
NE-51 Neon Lamps.	2	Front Panel.

SECTION II

THEORY OF OPERATION

1. GENERAL SYSTEM OPERATION (See figure 4-5)

a. GENERAL - - The Polarad Model R Microwave Receiver is a triple-conversion superheterodyne receiver. Signals applied to the Tuning Unit are coupled to the first mixer through an RF preselector. A second frequency conversion occurs in the preamplifier, with its output coupled to the IF Amplifier. Here, a third frequency conversion is used to avoid high gain at one frequency. A klystron local oscillator is used in the first mixer and a crystal controlled oscillator is used in the second and third mixers. Detected signal and CW (40 mc) output is obtained from the IF Amplifier. (The 40 mc CW is applied to the FM Amplifier, the AFC portion of which is used to develop an amplified voltage which controls the frequency of the klystron local-oscillator and compensates for any long-period frequency shift.) The signal discriminator circuit detects FM on the input signal, and couples this to the Detected Signal Amplifier. The detected signal output of the IF Amplifier is used for the development of the AGC voltage, which is fed back to the Preamplifier (in the Tuning Unit) and to six stages of the IF Amplifier. The detected signal output also contains the audio or video envelope of any amplitude modulated signals applied to the receiver. These demodulated signals are made available for external observation and are applied to the Detected Signal Amplifier, for amplification and for the development of the trigger pulse.

b. TUNING UNIT - - The Model R Microwave Receiver may be operated with any one of eight Tuning Units installed in its cabinet. Each Tuning Unit contains a klystron local-oscillator, a preselector, a mixer, and a preamplifier with the necessary mechanical drive and tracking system. (Models RKS-T, RKU-T and RQ-T have no preselector.)

c. LOCAL OSCILLATOR CHASSIS - - The local-oscillator sub-chassis is crystal-controlled and produces an output at 120 mc (for application to the second mixer in the preamplifier) and 180 mc (for application to the mixer, tube V405, in the IF Amplifier).

d. IF AMPLIFIER - - The IF Amplifier consists of four stages of amplification at 140 mc, five stages at 40 mc, two detectors, and two cathode followers. A portion of the 40 mc signal voltage is applied to the FM Amplifier for AFC and signal output. One detector is used to obtain the AGC voltage; the other is used for signal detection, and feeds the two cathode followers. One cathode follower couples the signal to the Detected Signal Amplifier. The other couples the signal to a panel jack for oscilloscope observation.

e. FM AMPLIFIER - - This chassis consists of two cascaded amplifiers, which drive the AFC discriminator, and two cascaded limiters, which drive the signal discriminator. The AFC and signal discriminators are separate circuits, and operate independently of each other.

f. DETECTED SIGNAL AMPLIFIER - - This chassis consists of an audio amplifier (for detected low-frequency modulation), a pulse amplifier (for the 10-volt trigger pulse output) and the meter circuit (for relative RF measurements).

g. KLYSTRON POWER SUPPLY - - The Klystron Power Supply provides all the voltages necessary for the operation of the klystron local-oscillator. Proper operating voltages for each of the klystrons in the various Tuning Units are automatically selected through the mating plugs and receptacles mounted on each

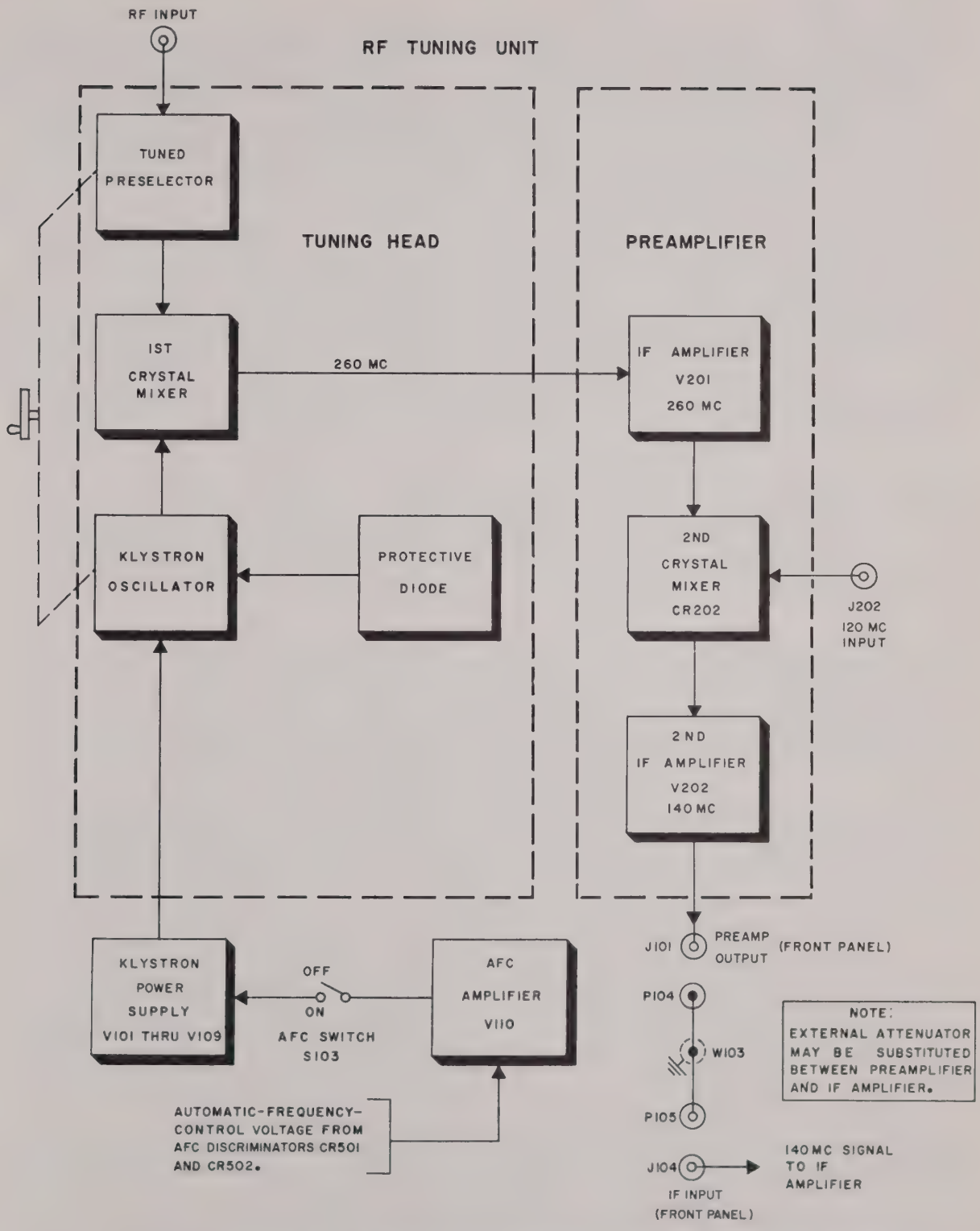


FIGURE 2-1. A TYPICAL TUNING UNIT, FUNCTIONAL BLOCK DIAGRAM.

of the Tuning Units. The AFC voltage developed in the FM Amplifier is applied to an AFC amplifier, tube V110, in the Klystron Power Supply. This voltage is used to vary the klystron reflector voltage and thereby compensates for drift or other gradual frequency variations. A delay relay is included in this circuit to permit application of reflector voltage to the klystron tube before application of anode voltage.

h. LOW VOLTAGE POWER SUPPLY - - The Low Voltage Power Supply provides a positive voltage of 120 volts d-c and a negative voltage of 108 volts d-c, necessary for the proper operation of the equipment.

2. TUNING UNIT, SYSTEM OPERATION (See figure 4-5)

a. GENERAL - - A brief discussion of a typical Tuning Unit is given in sub-paragraph b, below, as an aid to understanding overall equipment operation. Discussion of the theory of operation and procedures for chassis adjustments, for each Tuning Unit, are included in Parts II through IX of this instruction manual.

b. OPERATION - - A signal applied to the RF INPUT connector passes through a two-cavity preselector. The signal is then mixed with the output of the klystron local-oscillator, which is tracked to the preselector cavity. The difference frequency (the first IF at 260 mc) is amplified and applied to the second mixer. Also applied to this crystal mixer is the 120 mc output from the frequency doubler, V303, in the Local Oscillator chassis. The resultant signal, at a frequency of 140 mc, is applied through cables W102, W103, and W114 to the input of the IF Amplifier.

3. LOCAL OSCILLATOR SUB-CHASSIS (See figures 4-1 and 4-6)

a. OSCILLATOR-DOUBLER - - Tube V301 serves the dual function of crystal oscillator and frequency doubler. Crystal CR301 is a 30 mc crystal, connected in the cathode circuit of V301. The plate tank of V301A, tuned to 30 mc by inductor L302, is coupled via capacitor C327 to the grid of V301B. The B-section has its plate tank tuned to 60 mc by inductor L303. The 60 mc output from V301B is coupled through capacitor C307 to the control grid of V302.

b. AMPLIFIER - - Amplifier V302 is a conventional r-f amplifier. Its plate circuit is tuned to 60 mc (the incoming frequency) by inductor L308. Output is coupled via capacitor C328 to the frequency doubler, V303, and via capacitor C319 to the frequency tripler, V304.

c. FREQUENCY DOUBLER - - The plate circuit of doubler V303 is resonated to 120 mc by capacitor C313 and the primary of transformer T301. Output, taken from the secondary of T301, is applied through jack J302, coaxial cable W101, and jack J202 to the second crystal mixer in the Tuning Unit.

d. FREQUENCY TRIPLER - - The plate circuit of tripler V304 is resonated to 180 mc by capacitor C318 and the primary of transformer T302. Output, taken from the secondary of T302, is applied through jack J301, coaxial cable W104, and jack J402 to inductor L426, in the grid circuit of the third mixer V405 (located in the IF Amplifier).

4. IF AMPLIFIER (See figures 4-2 and 4-7)

a. 140 MC AMPLIFIERS - - With the exception of the input circuit to the grid of first IF Amplifier V401, the first four IF Amplifier stages are identical cascade-connected stages. All cathodes are returned to the de-coupled manual-gain control line. Control grids of these first four stages are returned to the automatic-gain control (AGC) line. This line also is equipped with de-coupling filters between stages. Voltage variations of this line, caused by amplitude variations at the AGC detector, control the gain of these stages. The plate circuits of tubes V401, V402, V403, and V404 are tuned to 140 mc by the inductor included in the succeeding grid circuit.

b. MIXER - - The 140 mc signal from V404 is coupled to the grid of the third mixer, V405. In addition, a 180 mc signal from frequency tripler V304 (in the Local Oscillator sub-chassis) is coupled via capacitor C443 from inductor L426 to this grid. The resultant 40 mc signal produced at the plate of V405 is coupled via C441 to the grid of IF Amplifier V406.

c. 40 MC IF AMPLIFIERS - - IF amplifiers V406 and V407 are identical. Like the first four IF stages, their cathodes are returned to the manual-gain control line, with their control grids returned to

the AGC line. Both V406 and V407 utilize capacitive coupling, with their grid inductors tuned to 40 mc. The output of V406 is applied to the grid of V407, is amplified by V407, and is applied to the grid of IF amplifier V408. The plate of V407 is tuned to 40 mc by inductor L437. Unlike the preceding stages, both the cathode and the control grid of V408 are returned to ground. Thus, no automatic or manual-gain control is exercised over V408. The output of this stage is coupled via capacitor C465 to inductor L447, in the grid circuit of V409. Inductor L447 is tuned to 40 mc. A portion of the signal developed across L447 is taken from a tap on the inductor and is coupled through capacitor C470 to FM connector J403. The signal is applied through coaxial cable W105 and connector J501 to the FM Amplifier. The full signal output developed across tuned inductor L447 is applied to the grid of V409. After amplification by V409, the signal is coupled via capacitor C476 to the plate of signal detector V410B and via C480 to the cathode of AGC detector V410A.

d. AGC DETECTOR - SIGNAL DETECTOR - - The dual diode V410 serves as both an AGC detector and a signal detector. A negative output voltage is provided at V410A. This output is fed through connector J406 and cable W107 to the FUNCTION SELECTOR S105 and to dc amplifier V607A of the VTVM circuit. (See paragraph 6 of this section.) The output from signal detector V410B is applied via capacitor C487 to the grids of trigger cathode follower V411, and via capacitor C488 to video cathode follower V412.

e. TRIGGER CATHODE FOLLOWER - - The positive output of signal detector V410B is applied to the grids of the parallel-connected dual triode V411, which serves as a cathode follower. The output of V411 is fed through coaxial connector J405 and coaxial cable W108 to the AM-FM switch, S107.

f. VIDEO CATHODE FOLLOWER - - The positive output of signal detector V410B is applied to the parallel connected grids of video cathode follower V412. The output of cathode follower V412 is fed through connector J404 and coaxial cable W109 to the AM-FM switch, S107, on the main chassis.

5. FM AMPLIFIER (See figures 4-3 and 4-8)

a. 40 MC AMPLIFIERS - - The 40 mc output of the IF Amplifier is coupled via transformer T501 to the control grid of amplifier V501. Tubes V501 and V502 are conventional IF amplifiers, connected in cascade. Both tubes have their plate inductors, L501 and L503, tuned to 40 mc. A portion of the signal developed across L503 is taken from a tap on the inductor and is coupled through capacitor C511 to the control grids of the AFC discriminator drivers, V505 and V506. The full signal developed across inductor L503 is coupled via capacitor C508 to the control grid of limiter stage V503.

b. 40 MC LIMITERS - - The purpose of the 40 mc limiters, tubes V503 and V504, is to clip any amplitude modulation on the 40 mc signal. Both limiters are overdriven amplifiers, which depend on plate current cutoff to clip the negative peaks, and plate current saturation to clip the positive peaks. They operate at low plate voltage and, in the absence of signal, at zero grid potential. Their plate circuits are tuned to 40 mc by inductors L512 and L507. Any a-c signal on the grid results in grid current and the development of a small negative grid bias, which establishes the operating point. The output of V504 is coupled via capacitor C519 to the control grids of the signal discriminator drivers, V507 and V508.

c. AFC DISCRIMINATOR DRIVERS - - The output signal from amplifier V502 is applied to the control grids of the discriminator drivers V505 and V506. The plate circuit of V505 is tuned to 38.25 mc by inductor L508, developing maximum output from V505 for signals of this frequency. The plate circuit of V506, on the other hand, is tuned to 41.75 mc by inductor L509, giving V506 maximum response to signals of the higher frequency. The output of both tubes V505 and V506 is fed to crystal diodes CR501 and CR502, respectively, functioning as AFC discriminator diodes.

d. AFC DISCRIMINATOR - - Crystal diodes CR501 and CR502, together, comprise the AFC discriminator. The output of V505 is coupled through capacitor C529 to CR502, while the output of V506 is applied through capacitor C555 to CR501 Both crystal diodes are connected in the circuit so that positive output voltages are produced. When the signal frequency from amplifier V502 is lower than 40 mc, the output of driver V505 is increased, and the d-c output from diode CR502 is greater than that from diode CR501. If the signal frequency from amplifier V502 is higher than 40 mc, the output of V506 is increased, and the d-c output from CR501 exceeds that from CR502. Operation at the 40-mc intermediate frequency causes

an equal output in both tubes V505 and V506, and therefore produces no difference in output from the two diodes. Capacitor C561, which is connected across the output of both diodes, filters out any frequency-modulation components. The output of the AFC discriminator is applied to the grid of the AFC Amplifier, V110, part of the klystron power supply mounted on the main chassis.

e. SIGNAL DISCRIMINATOR DRIVERS - - Signal discriminator drivers V507 and V508 are similar in operation to the AFC discriminator drivers. The difference lies in the frequencies to which the plate circuits are tuned. The plate circuit of V507 is tuned to 37 mc by inductor L514 and capacitor C526, while that of V508 is tuned to 43 mc by inductor L515 and capacitor C533. This 6-megacycle frequency difference is necessary to accommodate frequency-modulated signals. F-m signals having a deviation as great as plus-or-minus 1-1/2 mc are faithfully reproduced by the Model R Receiver. Output from V507 and V508 is fed to two separate crystal diodes, functioning as the signal discriminator.

f. SIGNAL DISCRIMINATOR - - Crystal diodes CR503 and CR504, together, comprise the signal discriminator. The output of V507 is coupled through capacitor C523 to CR504, while that of V508 is applied through capacitor C535 to CR503. Both crystal diodes are connected in the circuit so that positive output voltages are produced. When the signal frequency from limiter V504 is lower than 40 mc, the output of V507 is increased, and the d-c output from diode CR504 exceeds that from CR503. If the signal frequency from limiter V504 is higher than 40 mc, the output of V508 is increased, and the d-c output from CR503 exceeds that from diode CR504. Note that the output of CR503 places a voltage across the series combination of R544 and R543 which is positive at the high end, and negative at the ground end. On the other hand, the output of CR504 places a voltage across R544 and R543 which is negative at the high end and positive at the ground end. The high end of series resistors R544 and R543 is coupled through capacitor C543 to the grids of twin triode V509. Thus, a frequency modulated signal produces alternate positive and negative voltages across series resistors R544 and R543. These signal voltages, applied to the grids of V509, reproduce the envelope of the original modulation.

g. FM TRIGGER CATHODE FOLLOWER - - The alternating voltage, derived from the frequency-modulated signal by the signal discriminator, is applied to the control grid of one section of the twin-triode tube, V509B, which functions as a trigger cathode follower. The output of V509B is fed through connectors J502, P117, and coaxial cable W106 to the AM-FM switch S107A, contact 2.

h. FM VIDEO CATHODE FOLLOWER - - The output of the signal discriminator is also applied to the control grid of the other half of the twin triode, V509A, which functions as a video cathode follower. The output of this cathode follower is fed through connectors J504, P126, and coaxial cable W113 to the AM-FM switch S107B, contact 2.

6. DETECTED SIGNAL AMPLIFIER (See figures 4-4 and 4-9.)

a. VIDEO AMPLIFIER - - The output of cathode follower V411 (in the IF Amplifier) or FM cathode follower V509 (in the FM Amplifier) may be applied via the AM-FM switch, cable W111, and coaxial connector J602, to the input of first video amplifier, V604A. This stage is a conventional amplifier, employing cathode self-bias. Its output is coupled through capacitor C611 to the grid of grounded-cathode second video amplifier V601A. The output of V601A is coupled through capacitor C601 to the grid of third video amplifier V601B. This stage, like V604A, employs cathode self-bias. Output from its plate is coupled through capacitor C604 to the control grid of fourth video amplifier V602. This tube further amplifies the signal and applies it to pulse cathode-follower V603. This stage provides a low-impedance pulse output through capacitor C607, coaxial connector J603, and cable W112, to the front panel TRIGGER OUTPUT connector J103.

b. AUDIO AMPLIFIER - - The AM-FM switch applies the output of either trigger cathode follower V411 or FM cathode follower V509 to the AUDIO GAIN control. The signal taken from this control passes through cable W110 and AUDIO INPUT jack J601 to the grid of audio amplifier V604B. This tube is self-biased, with its cathode resistor R619 unbypassed, to provide negative feedback. The feedback circuit aids in maintaining fidelity. Output is coupled through capacitor C608 to the audio output stage. The signal from V604 is applied to the control grid of audio output tube V605. This stage is a conventional audio output amplifier, utilizing output transformer T601 in its plate circuit. The secondary of transformer T601 provides an output impedance of 500 ohms. The winding is connected to supply the audio signal to AUDIO OUTPUT connector J108, on the front panel.

c. VACUUM-TUBE VOLTMETER - - The peak reading vacuum tube voltmeter consists of hi-mu triode V608 and triode-pentode V607. The pentode section V607A, is wired to function as a diode. The negative pulse output from AGC detector V410A is applied via coaxial cable W107 to the cathode of V607A. As this tube conducts, capacitor C606 charges to the peak value of the IF signal and remains at this level, due to the relatively long discharge time constant through resistors R 629 and R 630. The AGC output is developed through cathode follower V608. Cathode follower V607B is directly coupled to V608 and provides a low impedance output to the meter. In the 30 db and 70 db positions of METER SCALE switch S106, the meter provides a decibel indication of signal strength. In the LINEAR position, the deflections are directly proportional to the signal input.

7. FRONT PANEL CONTROLS (See figures 3-2 and 4-10)

a. FUNCTION SELECTOR S105 - - The output of AGC detector V410A is fed through coaxial cable W107 to FUNCTION SELECTOR S105. Sub-paragraphs (1) and (2) below describe circuit operation in the two positions of the FUNCTION SELECTOR.

(1) PEAK POSITION - - With S105 in its PEAK position, the meter signal is obtained from the peak reading vacuum-tube voltmeter (see paragraph 6c, above) via connector P605 and cable W118.

(2) AVERAGE POSITION - - The operation of S105 in its AVERAGE position is dependent on the position of METER SCALE selector S106. With S106 in its LIN position, the VTVM circuit is bypassed and the meter signal is obtained directly from detector V410A through an R-C circuit comprised of R154 and C120. In the 30 db or 70 db positions of S106, the meter signal is obtained from the VTVM circuit, as in the PEAK position (see sub-paragraph (1), above), but capacitor C120 is inserted at the input of dc amplifier V607A to provide the proper time constant for an average reading on the meter.

b. METER SCALE SELECTOR S106 - - The proper series resistors for the 30 db, 70 db or 0-10 linear full-scale readings of the meter are selected by METER SCALE selector S106. This switch also serves to turn off the AGC in the LIN position, by grounding the AGC line. The output leads from S106 are connected to the panel-mounted meter via METER SELECTOR S104.

c. METER SELECTOR S104 - - METER SELECTOR S104 provides a means of utilizing the front-panel meter as a monitoring device for voltages and currents of the klystron local-oscillator. Switch positions are provided for measuring anode voltage, reflector voltage, anode current, crystal current, B plus voltage, and B minus voltage. An additional position of switch S106, designated USE, places the meter in the circuit to provide conventional output readings. The meter, in addition to its three output scales, (30 db, 70 db, and LIN), has a fourth scale for test purposes. This scale makes it possible for a single bracketed area, designated "VOLT" on the meter face, to indicate proper values for anode voltage, reflector voltage, plus 120 volts, and minus 108 volts. The crystal mixer current is adequate as long as the meter pointer does not deflect further to the left than 0.1 milliamperes, as shown on the linear meter scale. For anode current, use the 0-10 ma linear scale and multiply the reading by four. A RECORDER OUTPUT connector, J109, is provided on the front panel and may be used in all positions of S104 for recording on an external instrument.

8. KLYSTRON POWER SUPPLY (See figure 4-10)

a. DELAY RELAY - - Power to transformer T101 is delayed by relay K101, to permit application of power to all filaments and to the reflector of the klystron tube, before application of voltage to the cathode

of the klystron. When power is applied to relay K101, its resistance element becomes heated. After a time delay, this heating actuates the relay contacts, closing the circuit to T101 and to the coil of holding relay K103. The holding relay contacts keep the circuit to T101 closed, at the same time that power is removed from the delay-relay heating element.

b. KLYSTRON ANODE SUPPLY - - Rectifiers V101 and V102 are full-wave rectifiers, with their outputs added. The filament of V101 is returned through series regulator V103 and resistor R151 to ground. The negative output of rectifier V101, taken at the center tap of the first high voltage winding, at terminal 8 of T101, is returned to the filament of V102. Negative output, the amplitude of which is the sum of the voltages of both rectifiers, is taken from the center tap of the second high voltage winding, at terminal 11 of T101. This voltage is applied across the voltage regulator, consisting of series regulator V103, voltage control amplifier V104, and voltage reference tube V105. This regulator produces output voltage which is independent of variations in supply voltage and load over a wide range. Operation of the circuit is as follows:

(1) The output voltage of the regulator is developed across bleeder resistors R119, R108, R109, R110, R111, R112, and R113 in parallel with the resistance of the load. These resistors and the resistance of the load make up one part of the resistance of a voltage divider. The other resistance, through which all of the load current must flow, is the plate-to-cathode resistance of series regulator V103. The other elements in the circuit are used to control the resistance of V103, and thereby to maintain a constant voltage across the load.

(2) The plate voltage of V104 is the amplified output voltage of the supply. The potential at the grid of V104 is held at a constant value by voltage reference tube V105. The cathode potential of V104 is set to a voltage selected by ANODE V ADJ control R109. This control is set so that the cathode voltage is more positive than the grid by an amount which causes V104 to pass a certain plate current. This plate current flows through plate load resistor R104, and causes a drop across it. The magnitude of the voltage across this resistor is the bias on tube V103. The adjustment of control R109 establishes the resistance of V103, and thereby sets the load voltage which the regulator maintains.

(3) If the load voltage tends to increase (due to a decrease in load current or an increase in input voltage), the voltage on the cathode of V104 tends to become more negative. The grid voltage remains almost constant because of the presence of V105. The increase of negative potential on the cathode of V104 (a reduction in bias) causes V104 to conduct more heavily. A greater current flows through R104, which causes a greater voltage drop across this resistor. This voltage, which is the bias voltage for V103, causes the plate resistance of V103 to increase. A larger portion of the output voltage from the rectifiers appears across the higher resistance of V103, and the load voltage remains practically constant. The action is opposite for a line or load variation which tends to make the load voltage decrease.

c. KLYSTRON REFLECTOR SUPPLY - - Rectifier V106, series regulator V107, voltage control amplifier V108, and voltage reference tube V109 comprise the main parts of the klystron reflector supply. This is a regulated supply, the action of which is similar to that of the anode supply described in sub-paragraph b, above. The negative output of the reflector supply is added to the negative output voltage of the cathode supply, to provide a total reflector voltage which is the sum of the two regulated outputs.

d. AFC AMPLIFIER - - Included in the klystron reflector supply is AFC Amplifier V110. The output of the AFC discriminator (located in the FM Amplifier) is applied between grid and cathode of V110. When the AFC switch is OFF, this tube does not function. With the AFC switch in its ON position, relay K102 is energized, placing the series combination of V110 and resistor R127 across part of the voltage divider at the output of the reflector supply. Changes in the output of the AFC discriminator, applied between grid and cathode of tube V110, vary its plate current. This action changes the voltage drop across the reflector voltage tracking potentiometers. This difference in voltage drop, in turn, changes the potential applied to the klystron reflector. Since differences in reflector voltage vary the oscillating frequency of a klystron, the AFC Amplifier compensates for frequency drift in the klystron oscillator.

9. LOW VOLTAGE POWER SUPPLY (See figure 4-10)

The low voltage power supply consists of parallel-connected rectifiers V111 and V112, parallel-connected series regulators V114 and V115, voltage control amplifier V116, voltage regulator tube V117, and bias rectifier V113. The action of this circuit is similar to that of a conventional electronically regulated supply. It should be noted that V117, in addition to acting as a voltage reference tube for the regulated supply, also acts as a regulator for the bias supply.

NOTES

*THE MODEL RQ-T TUNING HEAD INCORPORATES TWO WAVEGUIDE RF INPUTS.

**THERE IS NO CABLE CONNECTION BETWEEN THE FRONT PANEL & THE INPUT JACK ON THE RQ-T.

FRONT PANEL

RF INPUT {J701, J801, J901, J1001, J1101, J1201A OR J1202A*

W103 P104 PREAMP OUTPUT J101 P105 IF INPUT J104

TRIGGER OUTPUT J103 AUDIO OUTPUT J108 VIDEO OUTPUT J102

W104 W114

**W701, W801, W901 W1001, W1101 OR W1201 W102 W101

P103 P101 P107 P118

J203 J202 J402 J401

NOTE:
700 SERIES DENOTES MODEL RL-T TUNING HEAD
800 SERIES DENOTES MODEL RS-T TUNING HEAD
900 SERIES DENOTES MODEL RM-T OR RKS-T TUNING HEAD
1000 SERIES DENOTES MODEL RX-T OR RKU-T TUNING HEAD
1100 SERIES DENOTES MODEL RR-T TUNING HEAD
1200 SERIES DENOTES MODEL RQ-T TUNING HEAD

TUNING HEAD

J705 J805 J905 J1005 J1105 OR J1205

W702 W802 W902 W1002 W1102 OR W1202 P702 P802 P902 P1002 P1102 OR P1202

PRE-AMPLIFIER J206

J205 P116

H +120V
F MANUAL GAIN
E AGC
D 6.3V
C 6.3V
B XTAL METER
A GND
K
J

INDEX J K H L A B C D E F M N P R S T U V P119

GND 6.3V 6.3V -325V -700 OR -1250V 6.3V -925, -1300 OR -1850V 6.3V 115V AC 115V AC

W122

IF AMPLIFIER

J403 J405 J406 J404

P109 W105 P108 J501

P111 W113 P126 J504

P112 P117 J502

W107 W108 W106

FM AMPLIFIER

J503

1 GND 2 6.3V 3 6.3V 4 +120V 5 AFC 6 AFC 7 8 P120

W117

W111 W110 W112

P122 P113 P114 P115

J604 J601 J602 J603

W401

+120V MANUAL GAIN 6.3V GND AGC 6.3V SIGNAL DIODE

1 2 3 4 5 6 7 8 P401

J106

P110 W109

W116

MAIN CHASSIS

W118

6.3V 11
GND 10
AGC 9
METER 8
-108V 7 J605
6.3V 6
6.3V 5
+120V 4
AUDIO 3
2
6.3V 1
P121

DETECTED SIGNAL AMPLIFIER

P106 P102

J301 J302

LOCAL OSCILLATOR

W301

6.3V 6
GND 4
6.3V 3
+120V 1
P301 2 J107
5

J105

P124 W115

P123 115V AC

W123

FIGURE 3-1. INTER-UNIT CABLING DIAGRAM.

SECTION III
INSTALLATION & OPERATION

1. INSTALLATION

a. The Model R Microwave Receiver is shipped complete and ready for use. The usual general precautions for unpacking a delicate instrument are required. The instrument is portable and may be used for both laboratory and field tests.

b. To inspect the interior of the equipment, remove the dust cover, which serves as a carrying case for the equipment. This procedure is best accomplished in the following manner:

(1) Two captive-lock fasteners are located at each corner, at the rear of the dust cover. Release the locks, by turning each one-quarter turn counterclockwise.

(2) Slide the equipment out of the dust cover. Place the equipment on a work bench.

(3) The component parts mounted on the main chassis and on the Tuning Unit casting will now be visible and accessible.

c. Check to make sure that all tubes are firmly seated in their sockets, that tube shields are properly in place, and that all inter-unit cabling connections are firm and secure. Check inter-cabling between the various sub-assemblies within the receiver by reference to table 3-1 below.

CAUTION

Before the Model R Microwave Receiver is turned on, make certain that the 115-230 volt switch is set for appropriate input voltage.

2. CHECKING INTER-CABLING CONNECTIONS (See figure 3-1)

a. In checking that proper cables are securely connected to their mating receptacles, the table below lists each of the sub-chassis within the receiver, with a brief description of the power and signal cables required. Reference to the Inter-Unit Cabling Diagram will also help in checking connections.

NOTE

In the list of cables below, the following series of reference symbols are used for cables and connectors:

700 series applies to the RL-T Tuning Unit;
800 series applies to the RS-T Tuning Unit;
900 series applies to the RM-T and RKU-T Tuning Units;
1000 series applies to the RX-T and RKU-T Tuning Units;
1100 series applies to the RR-T Tuning Unit;
1200 series applies to the RQ-T Tuning Unit.

TABLE 3-1. INTER-CABLING CONNECTIONS

Cable Reference Symbol and Type	Terminating Connector	Cable Function
W101, RG-55/U, Coaxial	P101 and P102	Applies the 120 Mc Signal from jack J302, at the output of the frequency doubler (on the local oscillator chassis) via J202 (on the preamplifier) to the second crystal mixer.

TABLE 3-1. INTER-CABLING CONNECTIONS (cont)

Cable Ref. Symbol and Type	Terminating Connector	Cable Function
W102, RG-55/U, Coaxial.	P103 and J101.	Applies the output of the preamplifier (via J203) to the PREAMP OUTPUT jack J101 on the equipment front panel.
W103, or external attenuator.	P104 and P105.	Connects the PREAMP OUTPUT jack J101 to the IF INPUT jack J104 on the front panel.
W104, RG-55/U, Coaxial.	P106 and P107.	Applies the 180 Mc signal from the frequency tripler (in the local oscillator chassis) via J301 and J402 to the third mixer in the IF Amplifier.
W105, RG-55/U, Coaxial.	P108 and P109.	Applies the FM output (from V408) in the IF Amplifier via J403 & J501 to the FM Amplifier.
W106, RG-62/U, Coaxial.	One end P117, other end terminates in contact of switch S107.	Applies the output of the FM cathode follower (in the FM Amplifier) via J502 to the FM contact of switch S107.
W107, RG-62/U, Coaxial.	P112 and P122. Tapped for contact with FUNCTION SELECTOR S105.	Couples output of AGC detector (in IF Amplifier) via J406 to FUNCTION SELECTOR S105 and via J604 to the VTVM circuit.
W108, RG-62/U, Coaxial.	One end P111, other end terminates in contact of switch S107.	Applies the video signal from the trigger cathode follower (in the IF Amplifier) via J405 to the AM contact of switch S107.
W109, RG-62/U, Coaxial.	One end P110, other end terminates in contact of switch S107.	Applies the output of the video cathode follower (in the IF Amplifier) via J404 to the AM contact of switch S107.
W110, RG-62/U, Coaxial.	One end P113, other end terminates in the variable arm of AUDIO GAIN control R169.	Applies signal at an amplitude level determined by the setting of the AUDIO GAIN control via J601 to the audio amplifier (in the Detected Signal Amplifier).
W111, RG-62/U, Coaxial.	One end P114, other end terminates in wiper "A" of AM-FM switch S107.	In AM position of S107: Couples the output of the trigger cathode follower (in the IF Amplifier) via J602 to the video amplifier (in the Detected Signal Amplifier). In the FM position: Couples the output of the FM cathode follower (in the FM Amplifier) to the video amplifier (in the Detected Signal Amplifier).
W112, RG-62/U, Coaxial.	J103 and P115.	Applies the output of the pulse cathode follower (in the Detected Signal Amplifier) to the front panel TRIGGER OUTPUT jack.
W113, RG-62/U, Coaxial.	One end P126, other end terminates in contact of switch S107.	Applies the output of the FM video cathode follower (in the FM Amplifier) via J504 to the FM contact of switch S107.
W114, RG-55/U, Coaxial.	J104 and P118.	Applies the signal from the front panel IF INPUT jack to jack J401 on the IF Amplifier.

TABLE 3-1. INTER-CABLING CONNECTIONS (cont)

Cable Ref. Symbol and Type	Terminating Connector	Cable Function
W116, harnessed cable.	Multi-pin connector, P119.	Applies proper power to all tubes in the Tuning Unit via connectors listed below: J705 (for the RL-T Tuning Unit), J805 (for the RS-T Tuning Unit), J905 (for the RM-T and RKS-T Units), J1005 (for the RX-T and RKU-T Units).
W117, harnessed cable.	Multi-pin connector, P120.	Applies operating power to the tubes within the FM Amplifier. Also couples the output of the AFC Discriminator to the AFC Amplifier within the klystron power supply (in the main chassis).
W118, harnessed cable.	Multi-pin connector, P121.	Applies power and control signals to tubes within the Detected Signal Amplifier, via connector J605. Applies output of VTVM to meter circuit.
W122, harnessed cable.	Multi-pin connector, P116.	Applies power and control voltages via connector J205 to all tubes in the preamplifier.
W123, RG-62/U, Coaxial.	One end J102, other end terminates in wiper "B" of switch S107.	In the AM position of S107: Couples the output of the video cathode follower (in the IF Amplifier) from S107 to the VIDEO OUTPUT jack J102 on the front panel. In the FM position of S107: Couples the output of the FM video cathode follower (in the FM Amplifier) from S107 to the VIDEO OUTPUT jack J102 on the front panel.
W301, harnessed cable.	Multi-pin connector, P301.	Applies proper power potentials, via P301, to all tubes within the local oscillator chassis.
W401, harnessed cable.	Multi-pin connector, P401.	Applies proper power and control circuit signals via J106 to tubes within the IF Amplifier.
W702, W802, W902, W1002,W1002, and W1202, RG-71/U, Coaxial.	P-01 and P-02 (same series as cable)	Applies first crystal mixer output to J206 (input of preamplifier).

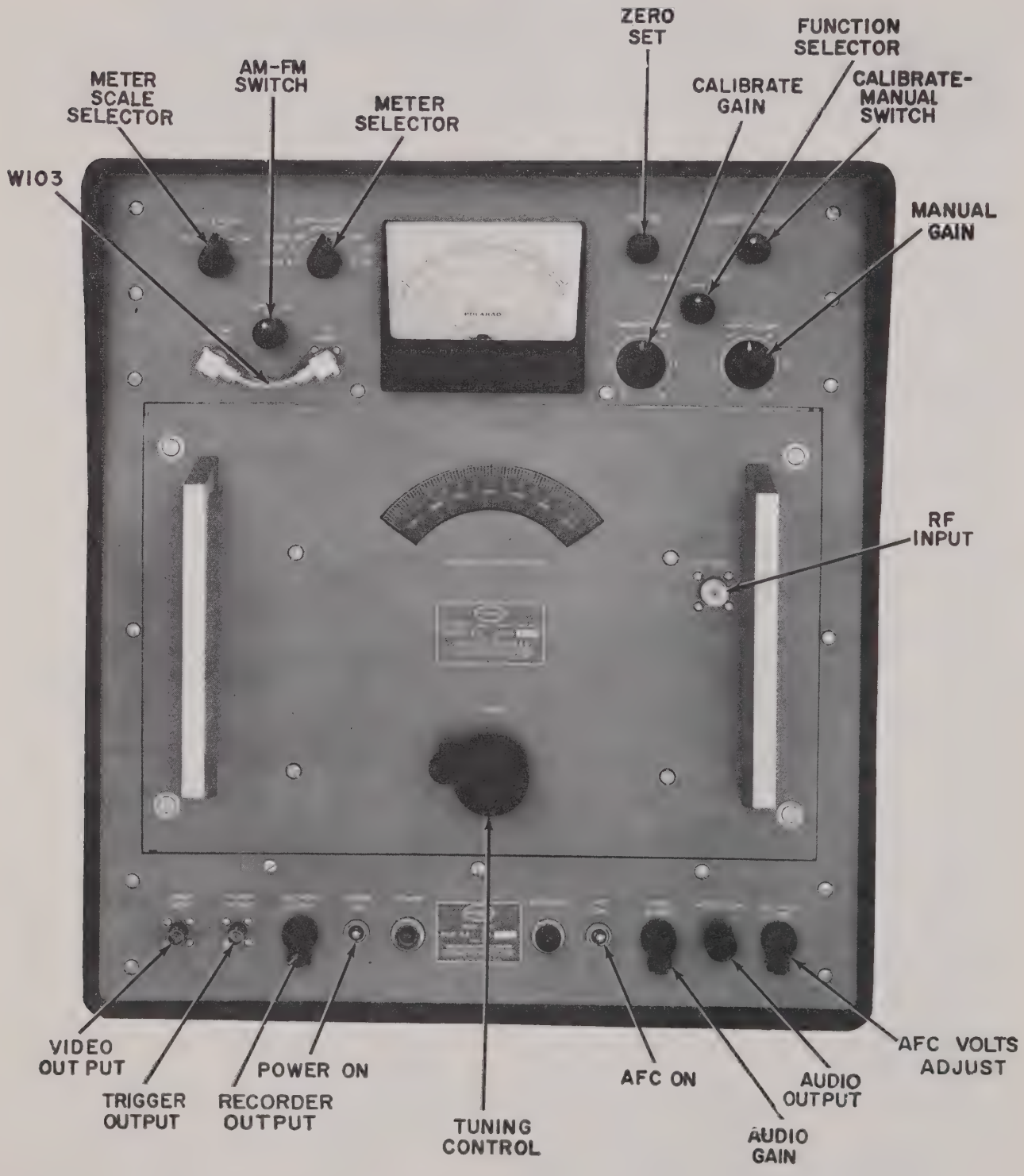


FIGURE 3-2. THE POLARAD MODEL R MICROWAVE RECEIVER, OPERATING CONTROLS.

3. OPERATING CONTROLS (See figure 3-2)

a. The operating controls required for operation of the Model R Microwave Receiver are listed in table 3-2 below.

TABLE 3-2. OPERATING CONTROLS

Control	Location	Function
POWER ON-OFF switch, S101.	Front panel, lower section.	Applies line power to the instrument.
METER SELECTOR switch, S104.	Front panel, upper section.	This rotary 7-position switch determines the use of the front panel meter. In the USE position, it connects the meter to the output of the RF metering circuits. The instrument may then be used for field intensity measurements, and allied uses. In the other 6 positions, the meter is employed to check the voltages or currents developed by various circuits in the equipment, as listed below: ANODE V. - Anode voltage REFL V. - Reflector voltage ANODE MA. - Anode current XTAL MA. - RF crystal current Plus 120 - Low voltage plate voltage supply Minus 108 - Low voltage biasing voltage supply
FUNCTION SELECTOR S105	Front panel, upper section.	This 2-position switch is set to correspond to the desired readings on the meter. a. In the PEAK position, it allows the METER SCALE switch S106 to obtain the metering signal from the VTVM circuit in the Detected Signal Amplifier sub-assembly. b. In the AVERAGE position, it performs the following functions: (1) If the METER SCALE switch S106 is in the LIN position, the metering signal is taken directly from the AGC detector V410A and passed through an R-C circuit consisting of R154 and C120 and then on to the meter. (2) In the 30 db or 70 db positions of S106, this switch performs the same functions as in the PEAK position, and in addition puts C120 at the input of V607A to change the time constant of the VTVM circuit.

TABLE 3-2. OPERATING CONTROLS (cont)

Control		Function
METER SCALE switch, S106.	Front panel, upper section.	This 3-position switch selects the desired meter range. Readings are taken from the corresponding scale: a. LINear: This scale provides a sensitive linear voltage measurement when receiving low power signals. In this position, the AGC line is grounded, disabling the AGC. b. 30 DB: This scale provides comparative signal-strength measurements in db, when the range of differences does not exceed 30 db. AGC is operative in this position. c. 70 DB: This scale provides comparative signal-strength measurements in db, when the range of differences does not exceed 70 db. AGC is operative in position.
MANUAL-CALIBRATE switch S108	Front panel, upper section.	In the MANUAL position, this switch introduces the MANUAL GAIN control into the circuit. In the CALIBRATE position, this switch introduces the CALIBRATE GAIN control into the circuit.
MANUAL GAIN control R167.	Front panel, upper section.	This potentiometer controls the overall gain of the instrument, with MANUAL-CALIBRATE switch in its MANUAL position, by varying the cathode bias of appropriate IF stages.
CALIBRATE GAIN control R168.	Front panel, upper section.	This potentiometer performs the same function as the MANUAL GAIN control, when the MANUAL-CALIBRATE switch is in its CALIBRATE position. It is used, together with the ZERO SET control, to calibrate the meter. Once this control is set, it is left undisturbed to provide a stable gain factor for measurement of signal strengths.

TABLE 3-2. OPERATING CONTROLS (cont)

AFC switch, S103.	Front panel, lower section.	This switch, in its ON position, causes the afc amplifier tube V110, to function. Conduction in tube V110 varies the reflector voltage applied to the klystron oscillator, compensating for any long-period frequency drift in the operation of the klystron.
AM-FM switch, S107.	Front panel, lower section.	a. In the AM position, this switch: (1) Applies the detected output of the IF Amplifier to both the pulse and audio sections of the Detected Signal Amplifier. Thus, it permits monitoring of amplitude-modulated signals, and triggering by the same type of signals. (2) Applies the detected output of the IF Amplifier to the VIDEO OUTPUT jack. Thus, it permits oscilloscope monitoring of amplitude-modulated signals. b. In the FM position, this switch: (1) Applies the detected output of the FM Amplifier to both the pulse and audio sections of the Detected Signal Amplifier, making possible both monitoring of, and triggering by, frequency modulated (FM) signals. (2) Applies the detected output of the FM Amplifier to the VIDEO OUTPUT jack, permitting oscilloscope monitoring of frequency modulated signals.
AUDIO GAIN control R169.	Front panel, lower section.	This potentiometer sets the level of audio output signals in the headset.
ZERO SET control R161.	Front panel, upper section.	This potentiometer is used, together with the CALIBRATE GAIN control, to zero set the meter when the FUNCTION SELECTOR is in its PEAK position.
AFC VOLT ADJUST R131.	Front panel, lower section.	This potentiometer is used to set the reflector voltage with AFC on, to the same level as with AFC off, with the receiver set up for calibrated gain and no signal input. Adjustment of this control varies the cathode bias on the AFC amplifier V110, in the Basic Unit.

4. INDICATORS (See figure 3-2)

a. The indicators which provide a visual check of the operation of the Model R Microwave Receiver are listed in table 3-3 below.

TABLE 3-3. INDICATORS

Indicator	Location	Function
POWER INDICATOR I 101.	Bottom of front panel.	This indicator is illuminated when line power is applied to the equipment.
KLYSTRON INDICATOR I 102.	Bottom of front panel.	This indicator becomes illuminated after delay relay K101 has been energized, showing that power has been applied to the anode voltage section of the high voltage supply.
METER M101.	Top of front panel.	This one-milliampere meter movement is the basic measurement device of the equipment. It indicates relative signal power on one of three scales: 30 db, 70 db, and LIN (linear). It is also used as a test meter to check internal voltages and currents of the instrument. a. When reading voltages, the meter pointer must fall within the area marked "Volt". When reading anode current, multiply the 0-10 ma linear by four. b. The crystal current may be read on the linear scale. The indication should always be greater than 0.1 ma.

NOTE

The functions of controls on the Tuning Unit are described in Parts II through VII of this instruction manual.

5. PRELIMINARY OPERATING PROCEDURE

CAUTION

Before the receiver is turned on, make sure that the 115-230 volt switch is in the appropriate position.

a. The Model R Microwave Receiver is factory-adjusted for proper alignment and operation, when shipped. No tuning adjustment, other than the main TUNING control on the Tuning Unit front panel, is required for operation of the equipment. Use the front panel controls only, during normal operation.

b. Proceed as directed below:

(1) Install the Tuning Unit, covering the desired frequency range, into the cabinet. See Section III, paragraph 2, of the applicable Tuning Unit Manual, for detailed instructions.

(2) Apply power to the instrument. Connect P124 at one end of the power cord to the power input receptacle J105, located at the rear of the chassis. Connect P123, at the other end of the power cord, to a 115/230 volt, 60 cycle, power source.

(3) Turn the POWER switch ON. The POWER indicator will become illuminated. After a 60 second delay, the KLYSTRON indicator will become illuminated, indicating proper operation of delay relay K101.

(4) Allow 20 minutes warm-up time.

CAUTION

With power on, extremely high voltages, which may be dangerous to life, are present within the main chassis and the Tuning Unit. Do not attempt to make adjustments within the main chassis or Tuning Unit, with operating power applied.

6. INPUT SIGNAL CHARACTERISTICS

a. The Model R Microwave Receiver is designed to accept signals which may vary considerably in frequency, modulation characteristics, and amplitude. Wide frequency coverage is provided by means of the six easily replaceable Tuning Units. A two-chamber coaxial preselector is gang-tuned with the klystron oscillator. The equipment is designed to monitor and to make comparative measurements of continuous-wave, amplitude-modulated, pulse-modulated, or frequency-modulated signals, within the microwave spectrum. An important consideration in the use of this instrument is the amplitude of input signals. The maximum usable sensitivity (defined as signal plus noise equal to twice noise) compatible with high overload capacity is provided.

b. The dynamic range of the Model R Microwave Receiver is extended to 70 db through the application of automatic gain control voltage to a total of nine amplifying stages, located in the Tuning Unit and IF Amplifier. Automatic gain control is applied when the METER SCALE switch is in the 30 db or 70 db positions. In the LIN position, AGC is not applied.

7. CALIBRATE GAIN

NOTE

The following procedure is very important. This procedure must be performed prior to the use of the 70 db or 30 db scales for comparative signal strength measurements and whenever the use of the AFC feature is desired. Basically, the method of maintaining the proper gain setting, for which the meter scales have been calibrated in db, is to utilize the inherent receiver noise and to keep it at a specified level. This procedure makes the accuracy of the Model R Receiver calibrated scales independent of variations in tube characteristics, or aging of components.

a. One variable in relative measurements of r-f energy that must be eliminated is instrument gain. The meter must be calibrated prior to the use of the 30 db or 70 db scales, and the gain setting must be left undisturbed. Proceed as follows:

(1) Place the MANUAL-CALIBRATE switch to its CALIBRATE position.

(2) Set the METER SELECTOR switch to its USE position.

(3) Set the FUNCTION SELECTOR to the AVERAGE position.

(4) Set the METER SCALE switch to its LIN position.

(5) With no signal present, vary the CALIBRATE GAIN control to obtain a meter pointer deflection of 1.5 on the linear scale.

(6) Set the METER SCALE selector to 70 db.

(7) Vary the ZERO SET control to obtain a meter pointer deflection of "0" on the LINEAR scale.

(8) The above adjustments compensate for inherent instrument noise. The CALIBRATE GAIN control must now be left undisturbed. When making measurements in which the calibrated meter is required, place the MANUAL-CALIBRATE switch to CALIBRATE. In this way, the gain factor is held constant for all measurements. If measurements are required at a different frequency setting, the CALIBRATE GAIN control may be used to re-zero the meter each time. This must be done to compensate for the change in noise voltage from crystal current changes, as the klystron local oscillator is tuned.

8. SPECIFIC APPLICATIONS

a. Paragraphs 6 and 7, above, described general considerations for the use of the Model R Microwave Receiver. Control settings of the instrument depend on the nature of the signal under investigation: its frequency, amplitude, and modulation characteristics. The function of the Tuning Unit is to tune the r-f section of the instrument to the frequency of the incoming signal. (See Parts II through VII of this instruction manual.) Paragraphs 9 through 16, below, give operating procedures for measuring and monitoring signals of various amplitudes and modulation characteristics.

9. CW SIGNALS

a. Field intensity, interference, and r-f leakage investigations usually involve continuous-wave signals. Proceed as directed below:

(1) Prepare the instrument for use, in accordance with paragraph 5, above.

(2) Calibrate the meter in accordance with paragraph 7, above, and leave the MANUAL-CALIBRATE switch in its CALIBRATE position.

(3) Tune in the signal by rotating the TUNING knob, on the Tuning Unit, to maximize the meter reading.

(4) Re-check the setting of the ZERO SET control by removing the input signal, or by de-tuning the receiver slightly.

(5) Use the 30 db or 70 db position of the METER SCALE selector, depending on the amplitude of the signals under measurement.

(6) Comparative measurements of signal strength, in db, may now be made through the use of the meter.

10. PULSE MODULATED SIGNALS

a. To measure the comparative power level of pulse-modulated signals, use the procedure outlined in paragraph 9, above, for c-w signals, with the exception listed below:

(1) Rotate the "Function Selector" to its PEAK position. The meter reading now indicates the relative power content of the pulsed signals, which may be compared with other pulsed signals at the same frequency.

b. For more accurate comparison of the power level of pulses, an external attenuator must be used. (See paragraph 14, below.)

c. The envelopes of the pulses may be compared by connecting an oscilloscope to the VIDEO OUTPUT receptacle, J102, on the front panel. The pulses may also be monitored aurally, if the duty cycle is sufficiently high, and if the pulse repetition rate falls within the auditory range. (See paragraph 12, below.)

d. Pulsed signals, which are 10 db above the tangential signal sensitivity, provide triggering pulses of 10 volts across 100 ohms at TRIGGER OUTPUT receptacle J103, on the front panel. To make these triggering pulses available, place the AM-FM switch in its AM position.

11. AM SIGNALS

a. For power measurements of AM signals, use the procedure applied to CW signals, as directed in paragraph 9, above. If the modulation frequency falls within the auditory range, the signal may be monitored with a headset at the front panel AUDIO OUTPUT receptacle. Rotate the AM-FM switch to its AM position, and use the front panel AUDIO GAIN control to adjust the signal level.

b. For weak AM signals, use the procedure outlined in paragraph 13, below. For accurate relative power measurement of weak signals, an external attenuator is required. (See paragraph 14, below.)

c. The modulation envelope may be observed by connecting an oscilloscope to the VIDEO OUTPUT receptacle, J102, on the front panel.

12. FM SIGNALS

a. Use the procedure applied to CW signals, as directed in paragraph 9, above. To monitor the signal aurally, rotate the AM-FM switch to its FM position. The FM signals are detected by a diode discriminator circuit. If the modulation frequency falls within the auditory range, it may be monitored at the AUDIO OUTPUT receptacle. Adjust the signal level by re-setting the AUDIO GAIN control. Monitor the modulation envelope, if desired, by connecting an oscilloscope to the VIDEO OUTPUT jack.

b. For weak FM signals, use the procedure described in paragraph 13, below.

13. WEAK SIGNALS

a. For very low-magnitude signals, maximum instrument sensitivity is desired. Proceed as directed below:

(1) Rotate the METER SCALE selector to its LIN position. This position provides maximum sensitivity since in this position the AGC is disabled.

(2) Place MANUAL-CALIBRATE switch to its MANUAL position. The MANUAL-GAIN control is now used to control the noise level.

(3) Observe pointer deflections of the panel-mounted meter on the linear (voltage) scale. The meter sensitivity is controlled by the METER SCALE selector. This procedure should be used for relatively uncritical applications, such as searching the band for low energy signals and establishing their frequencies. For accurate comparisons of low-energy signals, a calibrated external attenuator must be used. (See paragraph 14, below.)

14. USE OF AN EXTERNAL ATTENUATOR

For comparisons of the power level of r-f signals, an external calibrated attenuator (such as the Daven Attenuator, Type 651-R) may be used. Substitute this attenuator for the coaxial cable W103 between the PREAMP OUTPUT and the IF INPUT jacks on the front panel. For pulsed signals, set the instrument controls as directed in paragraph 10, above. For weak signals, set the controls as directed in paragraph 13. The attenuator is used for comparative power level measurements. Assume that the relative power of two signals is to be compared. Apply the first r-f signal to the R-F INPUT receptacle on the Tuning Unit. Set the external attenuator to provide a convenient meter pointer deflection. Note the db setting of the external attenuator. Now apply the second signal to the R-F INPUT receptacle. Vary the attenuator db adjustment to cause the same meter pointer deflection as the first signal. Note the db setting of the external attenuator. The difference between the two db settings of the attenuator is the difference in db between the average power of the two signals. To avoid any error due to a reduction in noise, the readings should be taken with signals at least 10 db above the noise level.

15. AUTOMATIC FREQUENCY CONTROL

Automatic Frequency Control (AFC), as provided in the Model R Receiver, is primarily designed to compensate for frequency drift that may take place in the receiver local-oscillator, or in the transmitter. Frequency control is accomplished by a feedback loop which maintains the last intermediate frequency (40 mc) constant. To accomplish this, the frequency of the klystron local oscillator is varied by changing its reflector voltage. If long-period monitoring of an r-f signal is required, use the AFC circuit by placing the AFC switch to its ON position. The AFC circuit is designed to operate only with the receiver MANUAL-CALIBRATE switch set up for calibrated gain. (See Part I, section III, paragraph 7.)

NOTE

Always tune for a signal with the AFC switch in its OFF position. If this is not done, a loss in signal resolution will result since the apparent bandwidth, with AFC ON, is 20 mc. In addition, incorrect reflector tracking occurs.

16. USE OF RECORDER

Meter readings may be recorded by means of a graphic recorder such as the Varian Model G-11, 100 mv. Connect the recorder to the RECORDER OUTPUT jack on the front panel of the Basic Unit.

17. MEASURING MODEL R SENSITIVITY

a. INTRODUCTION - - The sensitivity (where sensitivity is defined as the amount of signal necessary so that signal + noise = twice noise) of the Model R Receiver is measured by the following procedure. Equipment required consists of an RF Signal Generator, covering the frequencies under measurement, provided with a variable attenuator, accurately calibrated in dbm.

b. PROCEDURE.

(1) With no signal input applied, set up the Model R Receiver controls for the calibrated meter condition, at the frequency under measurement. (See Part I, Section III, paragraph 7.)

(2) Connect the output of the Signal Generator to the Receiver R-F INPUT jack. Vary the signal generator frequency control in the vicinity of the desired frequency to obtain a maximum meter pointer deflection.

(3) Increase the attenuation of the signal generator output, until the pointer on the Model R Receiver front panel meter deflects to "0" on the 70 db scale.

(4) The approximate Model R Receiver sensitivity in dbm is now equal to the Signal Generator attenuator dial reading.

SECTION IV
MAINTENANCE AND ALIGNMENT PROCEDURES

1. GENERAL

a. This section covers corrective maintenance procedures for the Polarad Model R Microwave Receiver. Included are the alignment procedures which may be required to restore the instrument to peak operating efficiency, following maintenance and repair. Coverage applies to the following five circuits:

(1) Power Supply Circuits, located on the Main Chassis,
(2) Local Oscillator Circuit,
(3) IF Amplifier,
(4) FM Amplifier,
(5) Detected Signal Amplifier.

b. All maintenance and alignment procedures for the Tuning Units are found in part II of this manual.

2. TROUBLE SHOOTING

a. The following description will assist maintenance personnel in locating sources of trouble:

(1) All mechanical drives and adjustment controls located in the Tuning Unit are discussed in the applicable parts of this manual. Use basic electronic trouble-shooting procedures, such as signal substitution, in maintaining the instrument.

(2) The panel-mounted meter may be used as the indicating device in trouble-shooting. With the METER SELECTOR rotated to its USE position, the meter and its associated circuitry are essentially a VTVM (vacuum-tube voltmeter). In the other positions of the METER SELECTOR; the meter serves as a test voltmeter or ammeter, and is connected to various points in the power supply or Tuning Unit circuits.

(3) The design of the instrument facilitates location of trouble. Any subassembly may be isolated by removing the signal cables connected to it. Signal substitution may then be used to sectionalize the source of malfunctioning.

(4) The multiple uses of the instrument often assist in trouble-shooting. For example, trouble may be localized to the audio, video, or metering stages of the Detected Signal Amplifier, through failure to obtain the normal output signal from the designated stages. (Refer to the applicable schematic circuit diagrams, at the rear of this section.)

(5) The alignment procedures described in this section may be used to isolate trouble. Failure to obtain the specified signal levels indicates improper functioning of that subassembly which is being aligned.

(6) Table 4-1, below, lists trouble symptoms and corrective measures, as an aid in localizing a defect in a particular circuit. Reference should be made to the receiver block diagram, Figure 4-5, to help localize the trouble to a particular unit or stage. The front panel meter can be used to check all power supply voltages and to check klystron local oscillator operation.

TABLE 4-1. TROUBLE SHOOTING CHART

Symptom	Probable Cause	Remedy
Low Sensitivity	Preselector out of adjustment.	Retrack preselector, according to alignment instructions.
	Defective crystal in first mixer.	Replace crystal.
	Low oscillator power.	Use panel meter to check klystron anode current, voltages and crystal current. Replace klystron, if necessary.
Low Noise Level.	Low gain in preamplifier.	Disconnect the front panel jumper. Noise output should cause the meter pointer to deflect to the "1" mark on the linear meter scale, with the "Function Selector" in the AVERAGE position, the METER SCALE switch in the LIN position, and the GAIN control set for maximum level. If this output level cannot be set, this is an indication that the gain of the preamplifier is low. Proceed as follows: a. Trouble shoot defective section. b. Replace defective tube (V201, V202). c. Realign.
	Low gain in the IF Unit.	Disconnect the front panel jumper. Noise output should cause the meter pointer to deflect to the "1" mark on the linear meter scale, with the "Function Selector" in the AVERAGE position, the METER SCALE switch in the LIN position, and the GAIN control set for maximum level. If this output level cannot be set, this is an indication that the trouble is in the IF Unit. Proceed as follows: a. Trouble shoot defective section. b. Replace defective tubes (V401 to V410). c. Realign.
Noise Normal, but no signal.	Defective crystal in RF mixer.	Replace crystal.
	Klystron oscillator not operating.	Check crystal current, anode current and klystron voltages.
	Defective klystron.	Replace klystron.
No Signal and low noise.	Defective second local oscillator (in preamplifier)	1. Trouble shoot preamplifier. 2. Replace CR301. 3. Replace tubes V301-V304.
AFC inoperative.	Defective AFC circuit.	1. Replace V110, V505, V506. 2. Check AFC FM alignment procedure.

TABLE 4-1. TROUBLE SHOOTING CHART (cont)

Symptom	Probable Cause	Remedy
Power light operates, but klystron light does not, after suitable delay	Defective delay circuit.	1. Replace K101. 2. Replace K103. 3. Replace pilot light I 102.
Over-heating of unit.	Dirty filter	Clean or replace filter.
No trigger output.	Defective pulse amplifier.	1. Trouble shoot defective section. 2. Replace tubes V601, through V604, V509, V411.
Weak audio output.	Defective audio amplifier.	1. Trouble shoot defective section. 2. Replace tubes V604, V605.
No video output. a. AM	Defective video amplifier.	1. Replace tube V412. 2. Check switch S107B contacts.
b. FM	Defective FM amplifier.	1. Replace tubes V501-V509. 2. Check switch S107B contacts.
Front panel meter operative, but recorder is inoperative.	Defective recorder jack.	Check continuity through J109.
In "USE" position, meter deflection is below 0, and pointer cannot be brought on scale.	Defective D. C. amplifier.	Check and replace, if necessary, V607 and V608.
In "USE" position, meter deflection is above full scale deflection, and cannot be brought on scale.	Defective D. C. amplifier.	Check and replace, if necessary, V607 and V608.

3. ADJUSTMENTS

The adjustment controls required for maintenance of the Model R Microwave Receiver are listed in table 4-2 below:

TABLE 4-2. ADJUSTMENT CONTROLS

Control	Location	Function
REFL ADJ, R125.	Bottom right side of main chassis.	This potentiometer adjusts the cathode bias of tube V108 for proper operation of the reflector voltage supply.
ANODE ADJ, R109.	Bottom right side of main chassis.	This potentiometer adjusts the cathode bias of tube V104 for proper output of the anode voltage supply.

TABLE 4-2. ADJUSTMENT CONTROLS (continued)

Control	Location	Function
120V ADJ, R148.	Bottom left side of main chassis.	This potentiometer adjusts the grid bias of V116 for proper operation of the low voltage B plus supply.
AFC ADJ, R131.	Right side of lower front control panel.	This potentiometer adjusts the cathode bias of the afc amplifier, V110, for proper operation of automatic-frequency-control.
70 db CALIBRATE.	Upper left side of main chassis.	This potentiometer adjusts the sensitivity of the meter for the 70 db scale.
30 db CALIBRATE.	Upper left side of main chassis.	This potentiometer adjusts the sensitivity of the meter for the 30 db scale.

4. POWER SUPPLY ADJUSTMENTS

a. INTRODUCTION - - For minor readjustments of the power supply voltages, the Model R Microwave Receiver front panel meter may be used. (For critical adjustment, using an external 20,000 ohm-per-volt voltmeter, the following procedure must be employed.) All of the test points necessary to perform the following adjustments are available on terminal board TB103, located on the left rear top deck of the main chassis, just forward of the blower motor.

CAUTION

Always connect voltmeter prods before turning on equipment power, because of the dangerously high voltages existing in these circuits. Do not contact the test prods, when power is applied to the instrument.

b. ANODE SUPPLY ADJUSTMENT - - If readjustment of the anode supply is required, proceed as directed below:

(1) Connect the negative test prod of a 20,000 ohm-per-volt voltmeter to terminal "F-1250" on TB103.

(2) Connect the positive test prod of the voltmeter to ground.

(3) Adjust ANODE V ADJ control R109 for the following indication on the voltmeter:

(a) If the Model RL-T, RR-T or RS-T Tuning Unit is in use, set the anode voltage to minus 325 volts, with respect to chassis ground.
(b) If the Model RM-T, RX-T, RKS-T or RKU-T Tuning Unit is in use, set the anode voltage to minus 1250 volts, with respect to chassis ground.
(c) If the Model RQ-T Tuning Unit is in use, set the anode voltage to minus 700 volts, with respect to chassis ground.

c. REFLECTOR SUPPLY ADJUSTMENT - - If readjustment of the reflector supply is required, proceed as directed below:

(1) Connect the negative test prod of a 20,000 ohm-per-volt voltmeter to terminal "N-1850 (-925)" on TB103.

(2) Connect the positive test prod of the voltmeter to terminal "F-1250" on TB103.

(3) With the AFC switch in its OFF position, adjust REFLECTOR V ADJ control R125 for a reading of 600 volts on the meter.

d. LOW VOLTAGE SUPPLY - - If readjustment of the low voltage power supply is required, proceed as directed below:

(1) Connect the positive test prod of a 20,000 ohm-per-volt voltmeter to terminal "+120" on TB103.

(2) Connect the negative test prod of the voltmeter to ground.

(3) Adjust the 120 V ADJ control, R148, for an indication of 120 volts on the voltmeter.

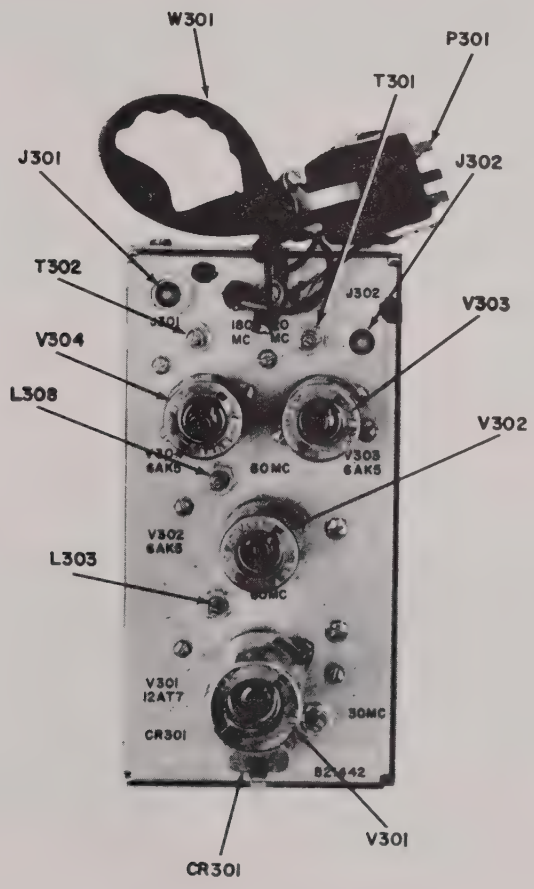


FIGURE 4-1. LOCAL OSCILLATOR CHASSIS, TOP VIEW.

5. LOCAL OSCILLATOR ALIGNMENT (See fig db 4-1 and 4-6)

a. PROCEDURE--Since the local oscillator circuits are crystal-controlled, peaking adjustments only are required. Use a VTVM, such as the Hewlett-Packard Model 400A or equivalent, in making all voltage measurements. Proceed as directed below:

(1) 120 MC OUTPUT: Peak coils L302, L303, L308 and the primary of transformer T301 for maximum output across a 50-ohm resistive load. Connect the 50-ohm load from coaxial connector J302 to chassis ground. An output of 0.7 volts rms across the 50-ohm load indicates satisfactory performance.

(2) 180 MC OUTPUT: Peak the primary of transformer T302 for maximum output across a 50-ohm resistive load. Connect the 50-ohm load from coaxial connector J301 to chassis ground. An output of 2.0 volts rms indicates satisfactory performance.

(3) If the outputs specified above are not obtained, check the grid voltages of tubes in the local oscillator chassis. Use a low capacity probe with a high series resistor, such as a 1-megohm, 1/2 watt resistor, for these measurements. The following voltage measurements indicate satisfactory equipment performance:

(a) V301B. . . . . -3 v DC
(b) V302. . . . . -5 v DC
(c) V303. . . . . -15 v DC
(d) V304. . . . . -15 v DC

6. IF AMPLIFIER ALIGNMENT (See figures 4-2 and 4-7)

a. EQUIPMENT REQUIRED - - A signal generator, with a calibrated output covering the frequency range from 37 mc to 145 mc, is required as the signal source for IF Amplifier alignment. The panel-mounted meter of the instrument is used as the indicating device. It is assumed that the local oscillator has been properly aligned, as directed in par. 5, and that it is furnishing the specified outputs.

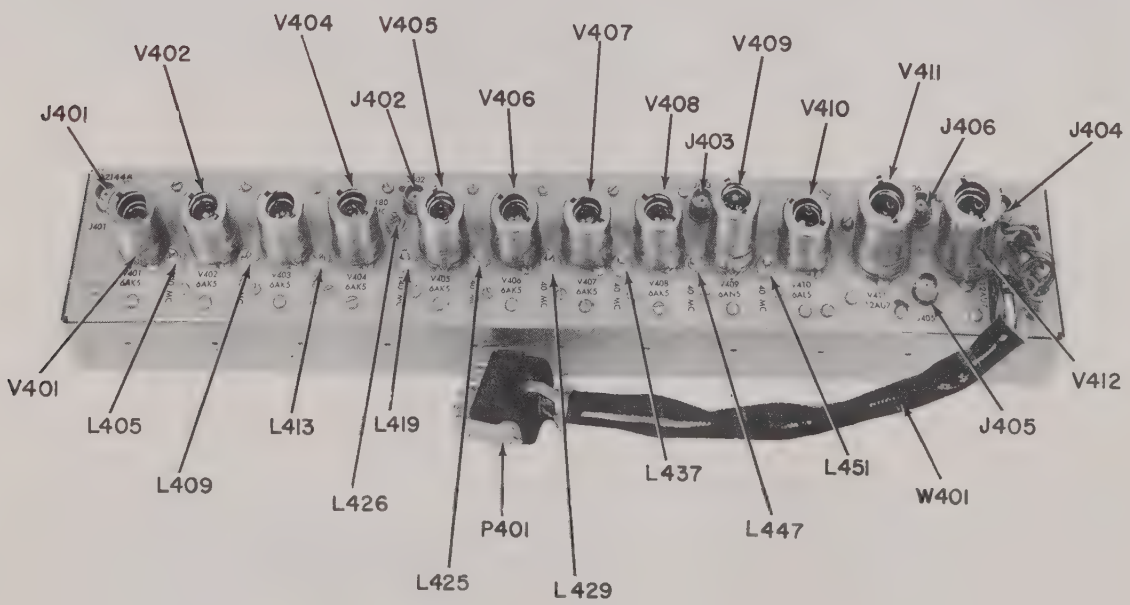


FIGURE 4-2. IF AMPLIFIER CHASSIS, TOP VIEW.

b. 40 MC STAGES - - To align the 40 mc stages, proceed as follows:

(1) Set METER SELECTOR to its USE position.

(2) Set the FUNCTION SELECTOR to its AVERAGE position.

(3) Set CALIBRATE-MANUAL switch to its MANUAL position.

(4) Set METER SCALE selector to its LIN position.

(5) Set the MANUAL GAIN control to its extreme clockwise position.

(6) Disconnect cable W103 from IF INPUT receptacle J104 (on the front panel). Also disconnect cable W104 from receptacle J402 on the IF Amplifier. (This removes the 180 mc signal which is normally applied to the IF Amplifier from the local oscillator tripler stage.)

(7) Apply a signal of 40 mc, at a level greater than 100,000 microvolts, to receptacle J402, on the IF Amplifier.

(8) Adjust coils L425, L429, L437, L447 and L451 for maximum pointer deflection on the panel-mounted meter.

c. 140 MC STAGES - - To align the 140 mc stages, proceed as follows:

(1) Use the control settings listed in b, above.

(2) Connect cable W104 to receptacle J402 on the IF Amplifier. (This connection applies the 180 mc output from the local oscillator tripler stage to the control grid of third mixer tube V405.)

(3) Apply a 140 mc signal, at a level greater than 10 microvolts, to the IF INPUT receptacle J104 (on the front panel).

(4) Peak coils L405, L409, L413, L419 and L426. Re-peak coil L447 for maximum d-c input to the FM Amplifier, as obtained at test jack J505.

(5) The following values indicate satisfactory equipment performance:

(a) Meter reading. . . . . 1.0 to 1.5 V, noise level.
(b) Sensitivity (signal plus Noise equals Twice Noise). . . . . approximately 3.5 microvolts.
(c) Bandwidth (between -3 db points). . . . . 3.0 to 3.5 mc.

7. FM AMPLIFIER ALIGNMENT (See figures 4-3 and 4-8)

a. EQUIPMENT REQUIRED - - In addition to a signal generator similar to the type specified in par. 4, above, use a VTVM having an r-f probe, such as the Hewlett-Packard Model 400A.

NOTE

Use a D.C. Probe for all measurements, unless otherwise specified.

b. AMPLIFIER AND LIMITER STAGES - - To align the amplifier and limiter stages, proceed as follows:

(1) Disconnect cable W105 from the 40 MC INPUT jack J501, located on the FM Amplifier chassis.

(2) Remove the four screws which secure the bottom cover to the FM Amplifier, and remove the cover.

(3) Connect the DC probe across grid resistor R534, which is common to driver tubes V507 and V508.

(4) Apply a signal of 40 mc to the 40 MC INPUT jack J501.

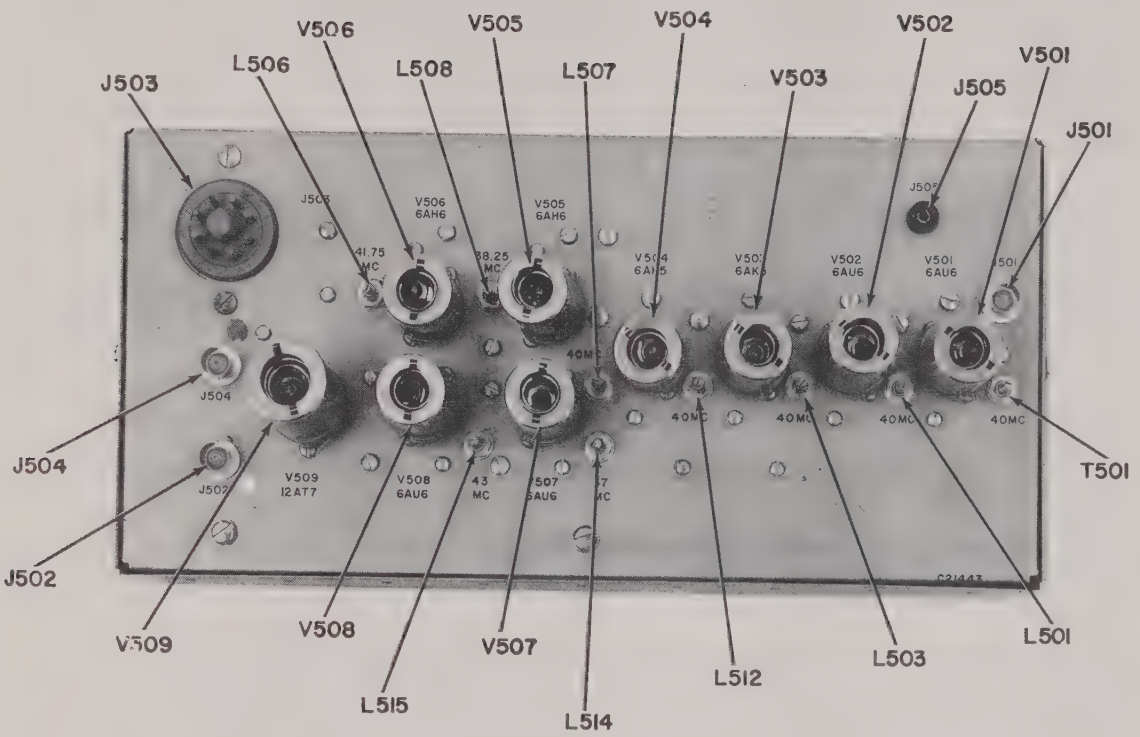


FIGURE 4-3. FM AMPLIFIER CHASSIS, TOP VIEW.

(5) Adjust T501, L501, L503, L512, and L507 for maximum output. Decrease the input from the signal generator, in order to maintain an output level below 0.5 V.

(6) Increase the signal input level to 50 millivolts, and connect the d-c probe of the VTVM (such as the Hewlett-Packard Model 400A) through a high-value isolation resistor to the grid, pin 1, of limiter V503. Retune inductor L503, in amplifier V502 plate circuit, for maximum pointer deflection on the VTVM. Remove the probe from the grid of V503, and connect the probe to the grid, pin 1, of limiter V504. Retune inductor L512, in limiter V503 plate circuit, for maximum pointer deflection on the VTVM. The following values indicate satisfactory equipment performance:

(a) Pin 1 V503. . . . . 6 v DC;
(b) Pin 1 V504. . . . . 5 v DC;
(c) A bandwidth of 6 mc.

c. SIGNAL DISCRIMINATOR STAGES - - To align the signal discriminator circuit, proceed as follows:

(1) With a 40 mc signal still being applied, retune L507 for maximum dc voltage across R543 and R544, as obtained through the probe.

(2) With an input of 50 millivolts, at a frequency of 37 mc, and with the probe across R543, tune L514 for maximum d-c voltage. An indication of approximately 2 volts negative shows proper functioning of the circuit.

(3) With an input of 50 millivolts, at a frequency of 43 mc, and with the probe across R544, tune L515 for a maximum d-c voltage. A voltage of approximately 2 volts positive shows proper functioning of the circuit.

(4) With the probe across R544 and R543, plot a curve of the d-c output as a function of frequency, (from 35 mc to 45 mc). The zero output point should occur at 40 mc. If this point occurs at some other frequency, retune L514 and L515 to bring the zero output point to 40 mc.

NOTE

If the d-c voltage obtained in steps 2 and 3, above, differ by more than 30%, or if the positive or negative peaks obtained in step 4, above, differs by more than 30%, it may be necessary to replace tubes V507 and/or V508, or crystal diodes CR503 and/or CR504, in order to meet the limits described above and obtain a better characteristic curve.

d. AFC CIRCUIT - - To align the AFC discriminator circuit, proceed as follows:

(1) Turn capacitor C511 to its maximum capacity.

(2) With an input of 50 millivolts at a frequency of 38.25 mc and with the DC probe across R532, tune L508 for maximum pointer deflection. A potential of approximately 2 volts shows proper functioning of the circuit.

(3) With an input of 50 millivolts at a frequency of 41.75 mc and with the DC probe across R533, tune L509 for maximum pointer deflection. A potential of approximately 2 volts shows proper functioning of the circuit.

(4) With the probe across R533 and R532, plot a curve of the d-c output as a function of frequency (from 35 mc to 45 mc). Proper operation is indicated when the zero output point occurs at 40 mc. If this point occurs at some other frequency, retune L508 and L509 to bring the zero output point to 40 mc.

NOTE

If the d-c voltage obtained in steps 1 and 2, above, differ by more than 30%, or if the positive or negative peaks obtained in step 3 differ by more than 30%, it may be necessary to replace tubes V505 and/or V506, or crystal diodes CR501 and/or CR502, in order to meet the limits described above and obtain a better characteristic curve.

(5) Reconnect cable W105 to J501 and feed a 140-mc signal into IF INPUT jack J104. With an input frequency of 140 mc, retune T501 for maximum bias, as measured with the probe at the grid, pin 1, of V503

NOTE

The IF Amplifier must be aligned before readjusting the setting of T501.

(6) Set up the receiver to operate at calibrated gain, as directed in Section III, paragraph 9, of this manual. Rotate the "Function Selector" to its PULSE AGC position.

(7) With the r-f probe at the junction of resistors R525 and R528, adjust trimmer capacitor C511 for 0.1-volt meter pointer deflection. (Re-tune inductor L503 to obtain a maximum meter pointer deflection.)

NOTE

See Part I, Section IV, paragraph 11, for final adjustment of the AFC circuits.

e. CHECK OF 20 DB QUIETING LEVEL.

(1) Connect the vertical input of an oscilloscope, having a video bandwidth of at least 5 mc (such as the Tektronix Model 514D) to the FM VIDEO OUT jack J502, located on the FM Amplifier chassis. Adjust the oscilloscope attenuator so that the noise output occupies a convenient height on the screen, and determine a position of the oscilloscope attenuator where 20 db less noise also occupies the same height on the screen.

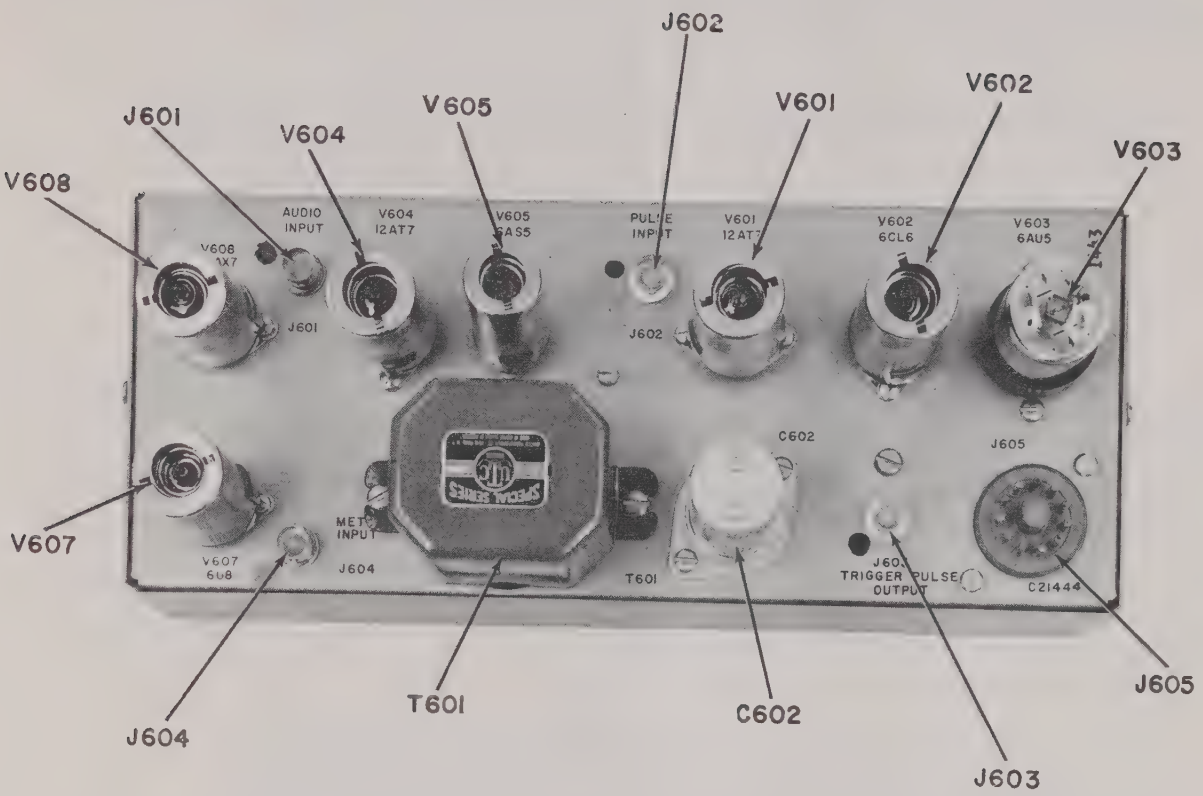


FIGURE 4-4. DETECTED SIGNAL AMPLIFIER CHASSIS, TOP VIEW.

(2) Feed a c-w (continuous-wave) signal at a frequency of 140 mc to the IF INPUT jack J104, located on the front panel. Set the attenuator on the signal generator for minimum signal level output.

(3) Increase the signal level output of the signal generator, observing the effect on the noise pattern on the oscilloscope screen. The noise level output should decrease. At a level of approximately 30 microvolts input, the noise output will have been reduced by 20 db This indication shows proper functioning of the equipment.

NOTE

If more than 30 microvolts is required, retuning of L503 and L512 may be necessary in order to obtain the 20 db quieting level.

8. CALIBRATION OF THE 70 DB METER SCALE

a. To calibrate the 70 db METER SCALE, use an accurately calibrated RF signal source and proceed as directed below, after setting up the equipment for calibrated gain. (See Part I, Section III, paragraph 7.)

(1) Set the FUNCTION SELECTOR to its AVERAGE position.

(2) Rotate the METER SELECTOR to its USE position.

(3) Rotate the METER SCALE selector to its 70 db position.

(4) Apply an r-f signal, within the frequency range of the Tuning Unit in use, to the front panel RF INPUT receptacle.

(5) Set the attenuator of the accurately calibrated signal source to an indication that causes the pointer of the panel-mounted meter (on the Model R Receiver) to deflect to the "0" calibration mark on the uppermost meter scale. Note the attenuator setting at this point. For example, assume that an attenuator setting of 85 db is required to produce a "0" pointer deflection on the panel-mounted meter.

(6) Decrease the attenuator setting on the accurately calibrated signal source exactly 70 db below the setting obtained in step (5) above. In our example, this would require resetting of the attenuator dial to a reading of 15 db.

(7) The pointer of the panel-mounted meter should now deflect precisely to the "70" db calibration mark on the uppermost meter scale. If this deflection is not obtained, use a screwdriver to reset the 70 db ADJ control R158, located on the main chassis. Adjust R158 to cause the pointer of the panel-mounted meter to deflect to the 70 db mark.

(8) Recheck the zero calibration mark. If the attenuator setting has changed, repeat the procedure outlined in steps (5) through (7), above.

9. CALIBRATION OF THE 30 DB METER SCALE

a. To calibrate the 30 db METER SCALE, use the same accurately calibrated r-f signal source as required for the procedure of par. 9, above:

(1) Set the FUNCTION SELECTOR to its AVERAGE position.

(2) Rotate the METER SELECTOR to its USE position.

(3) Rotate the METER SCALE selector to its 30 db position.

(4) Apply an RF signal, within the frequency range of the Tuning Unit in use, to the front panel RF INPUT receptacle.

(5) Set the attenuator of the accurately calibrated signal source to an indication that causes the pointer of the panel-mounted meter (on the Model R Receiver) to deflect to the "0" calibration mark on the 30 db METER SCALE. Note the attenuator setting at this point. For example, assume that an attenuator setting of 85 db is required to produce a "0" pointer deflection on the panel-mounted meter.

(6) Decrease the attenuator setting on the accurately calibrated signal source exactly 30 db below the setting obtained in step (5) above. In our example, this would require resetting of the attenuator dial to a reading of 55 db.

(7) The pointer of the panel-mounted meter should now deflect precisely to the "30" db calibration mark on the 30 db METER SCALE. If this deflection is not obtained, use a screwdriver to reset the 30 db

ADJ control R159, located on the main chassis. Adjust R159 to cause the pointer of the panel-mounted meter to deflect to the 30 db mark.

(8) Recheck the zero calibration mark. If the attenuator setting has changed, repeat the procedure outlined in steps (5) through (7), above.

10. AFC CIRCUIT ADJUSTMENT

a. If readjustment of the AFC Amplifier V110 circuit is required, proceed as directed below:

(1) Disconnect multi-pin plug P119, which terminates the harnessed cable W116, from the Tuning Unit.

CAUTION

Never work inside the Tuning Unit with operating power applied. Avoid shock hazard by removing operating power at all times when making adjustments on the Tuning Unit chassis.

(2) Connect the 140 mc output of the preamplifier to the IF Amplifier via coaxial cables W102, W103, and W114.

(3) Connect the probe of a VTVM across the output of the AFC Discriminator Circuit. These test points are available at pins K and L of multi-pin connector P119, or at pins 6 and 7 of connector J503, which is mounted on the FM Amplifier.

(4) Rotate the CALIBRATE-MANUAL switch to its CALIBRATE position. See Section III, paragraph 7 of this Instruction Manual.

(5) Retune inductor L508, in the plate circuit of driver V505, and inductor L509, in the plate circuit of driver V506, while observing the pointer deflection on the panel-mounted meter. First set the "Function Selector" to FI position; then rotate the "Function Selector" to PULSE AGC position. Adjust coils L508 and L509 to produce the same minimum noise voltage in both positions of the "Function Selector", (approximately zero voltage).

(6) Remove the VTVM from connector J503 on the FM Amplifier, and insert multi-pin connector P119 into its mating receptacle on the Tuning Unit.

NOTE

The following adjustment may be made, using the Model R front panel meter as an indicator, with the "METER SELECTOR" in the "REFL V" position.

(7) Place the AFC toggle switch to its ON position.

(8) Use a screwdriver to vary the setting of AFC ADJ control R131, located on the main chassis control panel, to produce a midscale pointer deflection on the external voltmeter. This voltage indication should be the same, whether the AFC is in its ON or OFF position.

b. After satisfactory completion of the steps listed in sub-paragraph a, above, the Model R Receiver will produce automatic-frequency-control on the reception of continuous-wave or pulse-modulated signals, with the equipment in calibrated operation. To obtain AFC control on the reception of pulse-modulated signals with the FUNCTION SELECTOR in its LIN position, set the MANUAL GAIN control knob to produce a linear meter reading of approximately 0.3 volt with no signal applied. This setting will also prove satisfactory for the reception of CW signals.

c. AFC will operate best for pulse-modulated signals when the duty cycle is greater than 1%.

11. VOLTAGE MEASUREMENTS

a. Table 4-3 lists voltages as measured from tube socket terminals to chassis ground, unless otherwise noted, with the Model RR-T, RL-T or RS-T Tuning Unit connected to the basic instrument. All measurements were taken with a Triplett Model 630-A voltmeter, having a sensitivity of 20,000 ohms-per-volt for d-c voltages, and 5000 ohms-per-volt for a-c voltages. Readings are dc. unless otherwise indicated.

b. Front panel controls were set as indicated below, in taking measurements:

METER SCALE . . . . . LIN
METER SELECTOR . . . . USE
FM-AM Switch . . . . . AM
CALIBRATE-MANUAL . . MANUAL
CALIBRATE GAIN . . . . . Fully counterclockwise
MANUAL GAIN . . . . Fully counterclockwise
AUDIO GAIN . . . . . Fully counterclockwise
ZERO SET . . . . . Mid-position
"Function Selector" . AVERAGE
AFC Switch . . . . . OFF, unless otherwise noted

TABLE 4-3. VOLTAGE MEASUREMENTS WITH MODEL RR-T, RL-T OR RS-T TUNING UNIT IN OPERATION

TUBE	PIN NUMBER								Remarks
	1	2	3	4	5	6	7	8	
V101	NC	370	NC	*620 ac	NC	*620 ac	NC	370	
V102	NC	*6.3 ac	NC	*620 ac	NC	*620 ac	NC	*6.3 ac	
†V103	0	340	-30	0.5	6.3 ac	-	-	-	
V104	-145	-135	-145	-145	-30	5	-135	-	
V105	0.5	-145	NC	-145	0.5	NC	-145	-	
V106	NC	65	NC	*1900 ac	NC	*1900 ac	NC	65	AFC OFF
	NC	75	NC	*1900 ac	NC	*1900 ac	NC	75	AFC ON
V107	-325	NC	65	NC	65	-475	-390	-475	AFC OFF
	-325	NC	70	NC	70	-475	-390	-475	AFC ON
V108	-475	-465	-475	-475	-390	-290	-465	-	
V109	-325	-475	NC	-475	-325	NC	-475	-	
V110	0	0	0	0	0	-930	0	-	AFC OFF
	-1160	-1160	-1160	-1160	-930	-1050	-1160	-	AFC ON
V111	NC	265	NC	*570 ac	NC	*570 ac	NC	265	
V112	NC	265	NC	*570 ac	NC	*570 ac	NC	265	
V113	-330	NC	0	6.3 ac	NC	-330	280 ac	-	
V114	80	240	125	80	240	125	0	6.3 ac	
V115	83	240	125	80	240	125	0	6.3 ac	
V116	-3.6	0	0	6.3 ac	83	120	0	-	
V117	0	-108	NC	-108	0	NC	-108	-	

* denotes measurement from pin to pin;
† denotes measurement from plate cap of V103 to chassis ground is 340 volts;
NC denotes no connection.

c. Table 4-4 lists voltages as measured from tube socket terminals to chassis ground, unless otherwise noted, with the Model RM-T, RX-T, RKS-T or RKU-T Tuning Unit connected to the basic instrument. All measurements were taken with a Triplett Model 630-A voltmeter, having a sensitivity of 20,000 ohms-per-volt for d-c voltages, and 5000 ohms-per-volt for a-c voltages. Readings are dc, unless otherwise indicated.

d. Front panel controls were set as indicated below, in taking measurements:

METER SCALE . . . . . LIN
METER SELECTOR . . . . USE
FM-AM Switch . . . . . AM
CALIBRATE-MANUAL . . MANUAL
CALIBRATE GAIN . . . . . Fully counterclockwise
MANUAL GAIN . . . . . Fully counterclockwise
AUDIO GAIN . . . . . Fully counterclockwise
ZERO SET . . . . . Mid-position
"Function Selector" . . AVERAGE
AFC Switch . . . . . OFF, unless otherwise noted

TABLE 4-4. VOLTAGE MEASUREMENTS WITH MODEL RM-T, RX-T, RKS-T OR RKU-T TUNING UNIT IN OPERATION

TUBE	PIN NUMBER								Remarks
	1	2	3	4	5	6	7	8	
V101	NC	420	NC	*1350 ac	NC	*1350 ac	NC	420	
V102	NC	-440	NC	*1350 ac	NC	*1350 ac	NC	-440	
†V103	0	420	-40	0.5	6.3ac	-	-	-	
V104	-145	-135	-145	-145	-40	7	-145	-	
V105	0.5	-145	NC	-145	0.5	NC	-145	-	
V106	NC	-890	NC	*1900 ac	NC	*1900 ac	NC	-890	
V107	-1250	NC	-890	NC	-890	-1400	-1350	-1400	
V108	-1400	-1400	-1400	-1400	-1350	-1250	-1400	-	
V109	-1250	-1400	NC	-1400	-1250	NC	-1400	-	
V110	0	0	0	0	0	-1850	0	-	AFC OFF
	-2100	-2100	-2100	-2100	-1850	-2000	-2100	-	AFC ON
V111	NC	265	NC	*590 ac	NC	*590 ac	NC	265	
V112	NC	265	NC	*590 ac	NC	*590 ac	NC	265	
V113	-330	NC	0	6.3 ac	NC	-330	285 ac	-	
V114	85	235	125	85	235	125	0	6.3 ac	
V115	85	235	125	85	235	125	0	6.3 ac	
V116	-3.7	0	0	6.3 ac	85	120	0	-	
V117	0	-108	NC	-108	0	NC	-108	-	

* denotes measurement from pin to pin;
† denotes measurement from plate cap of V103 to chassis ground is 420 volts;
NC denotes no connection.

e. Table 4-5 lists voltages as measured from tube socket terminals to chassis ground, unless otherwise noted, with the Model RR-T Tuning Unit connected to the basic instrument. All measurements were taken with a Triplett Model 630-A voltmeter, having a sensitivity of 20,000 ohms-per-volt for d-c voltages, and 5000 ohms-per-volt for a-c voltages. Readings are dc, unless otherwise indicated.

f. Front panel controls were set as indicated below, in taking measurements:

METER SCALE . . . . . LIN
METER SELECTOR . . . . USE
FM-AM Switch . . . . . AM
CALIBRATE-MANUAL . . MANUAL
CALIBRATE GAIN . . . . . Fully counterclockwise
MANUAL GAIN . . . . Fully counterclockwise
AUDIO GAIN . . . . . Fully counterclockwise
ZERO SET . . . . . Mid-position
"Function Selector" . AVERAGE
AFC Switch. . . . . OFF, unless otherwise noted

TABLE 4-5. VOLTAGE MEASUREMENTS WITH MODEL RR-T TUNING UNIT IN OPERATION

TUBE	PIN NUMBER								Remarks
	1	2	3	4	5	6	7	8	
V101	NC	370	NC	*625 ac	NC	*625 ac	NC	375	
V102	NC	*5 ac	NC	*625 ac	NC	*625 ac	NC	*5 ac	
†V103	*6.3 ac	375	-35	0.5	*6.3 ac	-	-	-	
V104	-145	-140	-145	-145	-34	30	-140	-	
V105	0.5	-145	NC	-145	0.5	NC	-145	-	
V106	NC	125	NC	*1900 ac	NC	*1900 ac	NC	130	AFC OFF
	NC	115	NC	*1900 ac	NC	*1900 ac	NC	135	AFC ON
V107	-325	NC	125	NC	125	-460	-400	-460	AFC OFF
	-325	NC	120	NC	-120	-460	-400	-460	AFC ON
V108	-460	-460	-460	-460	-400	-240	-460	-	
V109	-325	-460	NC	-460	-325	-290	-460	-	
V110	0	0	0	0	0	-920	0	-	AFC OFF
	-1110	-1110	-1110	-1110	-900	-1000	-1110	-	AFC ON
V111	NC	270	NC	*580 ac	NC	*580 ac	NC	270	
V112	NC	270	NC	*580 ac	NC	*580 ac	NC	275	
V113	-330	NC	0	6.3 ac	NC	-330	290 ac	-	
V114	85	230	125	85	230	125	0	6.3 ac	
V115	83	230	125	83	230	125	0	6.3 ac	
V116	-3.2	0	0	6.3 ac	85	120	0	-	
V117	0	-108	NC	-108	0	NC	-108	-	

* denotes measurement from pin to pin;
† denotes measurement from plate cap of V103 to chassis ground is 420 volts;
NC denotes no connection.

g. Table 4-6 lists voltages as measured from tube socket terminals to chassis ground, unless otherwise noted, with the Model RQ-T Tuning Unit connected to the basic instrument. All measurements were taken with a Triplett Model 630-A voltmeter, having a sensitivity of 20,000 ohms-per-volt for d-c voltages, and 5000 ohms-per-volt for a-c voltages. Readings are dc, unless otherwise indicated.

h. Front panel controls were set as indicated below, in taking measurements:

METER SCALE . . . . . LIN
METER SELECTOR . . . . USE
FM-AM Switch . . . . . AM
CALIBRATE-MANUAL . . MANUAL
CALIBRATE GAIN . . . . . Fully counterclockwise
MANUAL GAIN . . . . . Fully counterclockwise
AUDIO GAIN . . . . . Fully counterclockwise
ZERO SET . . . . . Mid-position
"Function Selector" . . AVERAGE
AFC Switch . . . . . OFF, unless otherwise noted

TABLE 4-6. VOLTAGE MEASUREMENTS WITH MODEL RQ-T TUNING UNIT IN OPERATION

TUBE	PIN NUMBER								Remarks
	1	2	3	4	5	6	7	8	
V101	NC	480	NC	*1000ac	NC	*1000ac	NC	480	
V102	NC	*5ac	NC	*1000ac	NC	*1000ac	NC	*5ac	
†V103	0	480	-43	0.67	6.0ac	-	-	-	
V104	-150	-140	-150	-150	-42	6.2	-140	-	
V105	0.67	-150	NC	-150	0.67	NC	-150	-	
V106	NC	-165	NC	*1900ac	NC	*1900ac	NC	-165	AFC OFF
	NC	-190	NC	*1900ac	NC	*1900ac	NC	-190	AFC ON
V107	-700	NC	-165	NC	-165	-830	-795	-830	AFC OFF
	-700	NC	-190	NC	-190	-830	-790	-830	AFC ON
V108	-830	-830	-830	-830	-795	-585	-820	-	
V109	-700	NC	NC	NC	NC	-700	NC	-830	
V110	0	0	0	0	0	-1300	0	-	AFC OFF
	-1500	-1500	-1500	-1500	-1200	-1400	-1500	-	AFC ON
V111	NC	265	NC	*590ac	NC	*590ac	NC	265	
V112	NC	265	NC	*590ac	NC	*590ac	NC	265	
V113	-330	NC	0	6.3ac	NC	-330	285ac	-	
V114	85	235	125	85	235	125	0	6.3ac	
V115	85	235	125	85	235	125	0	6.3ac	
V116	-3.7	0	0	6.3ac	85	120	0	-	
V117	0	-108	NC	-108	0	NC	-108	-	

* denotes measurement from pin to pin;
† denotes measurement from plate cap of V103 to chassis ground is 480 volts;
NC denotes no connection.

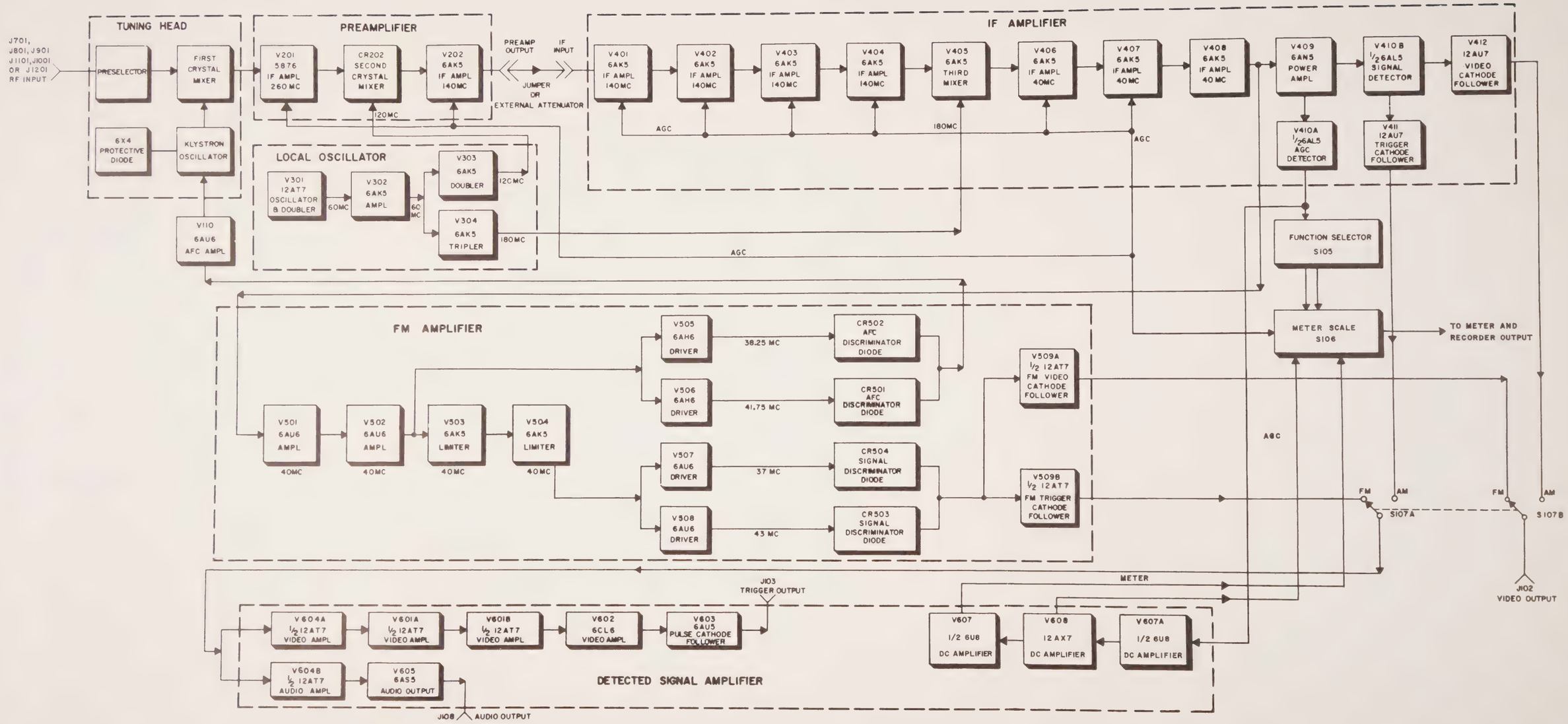


FIGURE 4-5. MODEL R MICROWAVE RECEIVER, FUNCTIONAL BLOCK DIAGRAM.

CP22522-7

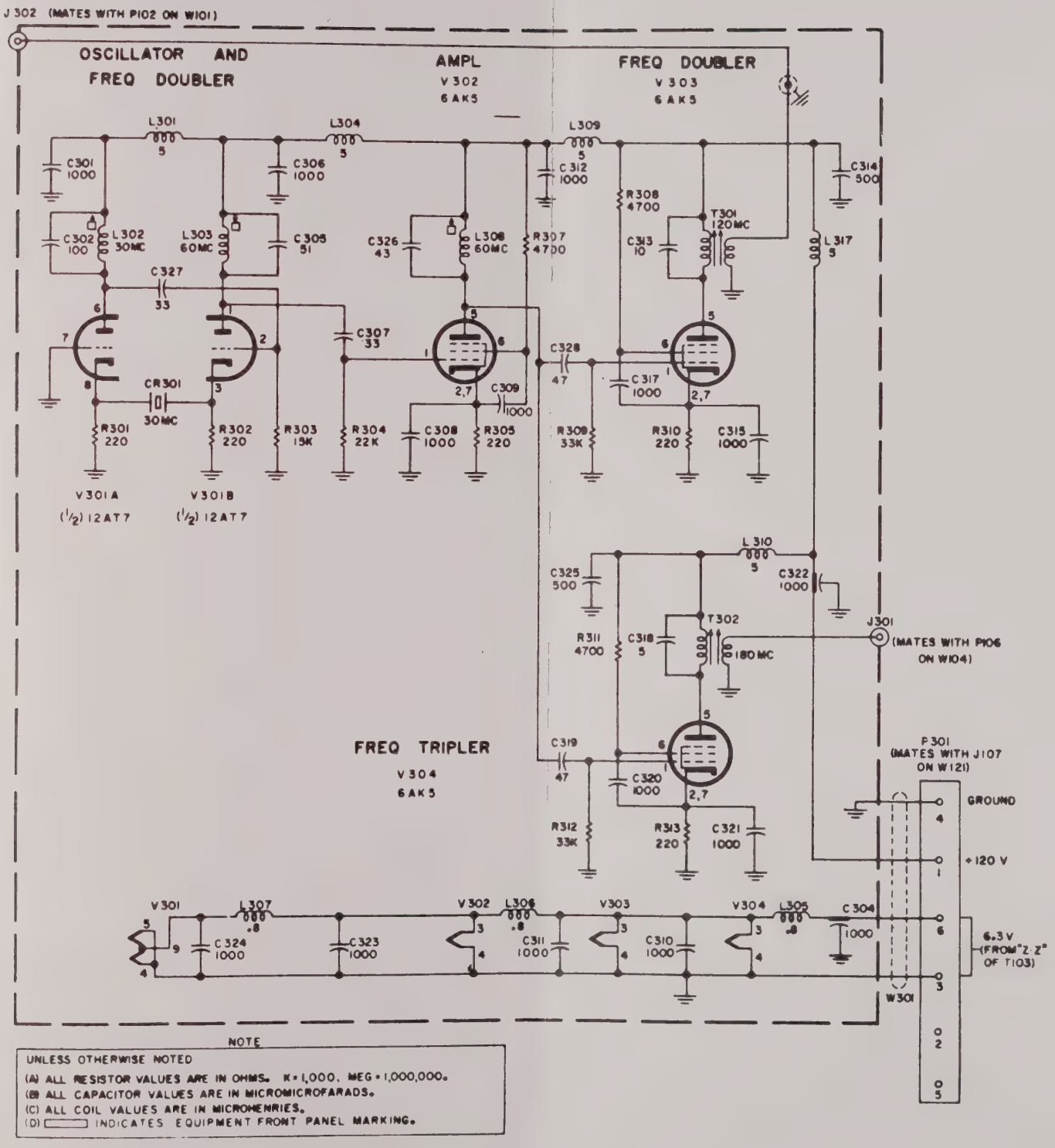


FIGURE 4-6. LOCAL OSCILLATOR, SCHEMATIC DIAGRAM.

I-F AMPL V401 6AK5

I-F AMPL V402 6AK5

I-F AMPL V403 6AK5

I-F AMPL V404 6AK5

THIRD MIXER V405 6AK5

I-F AMPL V406 6AK5

I-F AMPL V407 6AK5

I-F AMPL V408 6AK5

P118

J401 C401 L401

W114 RG-55/U

J104

IF INPUT

P105

W103 RG-58/U

P104

TO J101

PREAMP OUTPUT

(NOTE: ATTENUATOR MAY BE SUBSTITUTED FOR THIS EXTERNAL CABLE)

L402 L410 L411 L420 L423 L431 L435

R404 1800 C404 R408 1800 C415 R410 1800 C423 R415 1800 C428 R419 1000 C439 R422 1000 C450 R425 1000 C457 R429 1200

R403 15K R407 15K R409 15K R414 15K R416 47K R421 10 R424 10 R428 10

C410 C416 C425 C433 C441 C451 C458

C402 C411 C420 C429 C430 C438 C443 0-68 UUF C454

L405 140 MC L409 140 MC L413 140 MC L419 140 MC L425 40 MC L429 40 MC L437 40 MC

R401 560 C403 R402 180 C405 C413 R405 180 C417 C421 R411 180 C426 C431 R413 180 C434 C448 R417 390 C444 5UUF R418 4700 L426 180 MC C446 R423 180 C455 R427 180 R431 180

L403 L408 L414 L417 L418 L428 L438

C407 C414 C422 C432 C436 C447 C456 C463

L404 L407 L415 L416 L424 L427 L439

C408 C409 C419 C427 C442 C443 C452 C459

V401 L421 V402 L422 V403 L432 V404 L433 V405 L434 V406 L443 V407 L444

C435 C437 C440 C449 C453 C461 C464 C468

3 4 .8

J402

P107

TO J301 LOCAL OSCILLATOR SUB-ASSEMBLY

P106

W104 RG-55/U

TO J501 AFC-FM SUB-ASSEMBLY

P108

RG

NOTES

UNLESS OTHERWISE STATED:

(A) ALL RESISTOR VALUES ARE IN OHMS, K=1000, MEG=1,000,000.

(B) ALL CAPACITORS ARE 1000 MICROMICROFARADS.

(C) ALL COIL VALUES ARE IN MICROHENRIES.

(D) ▭ INDICATES EQUIPMENT FRONT PANEL MARKING.

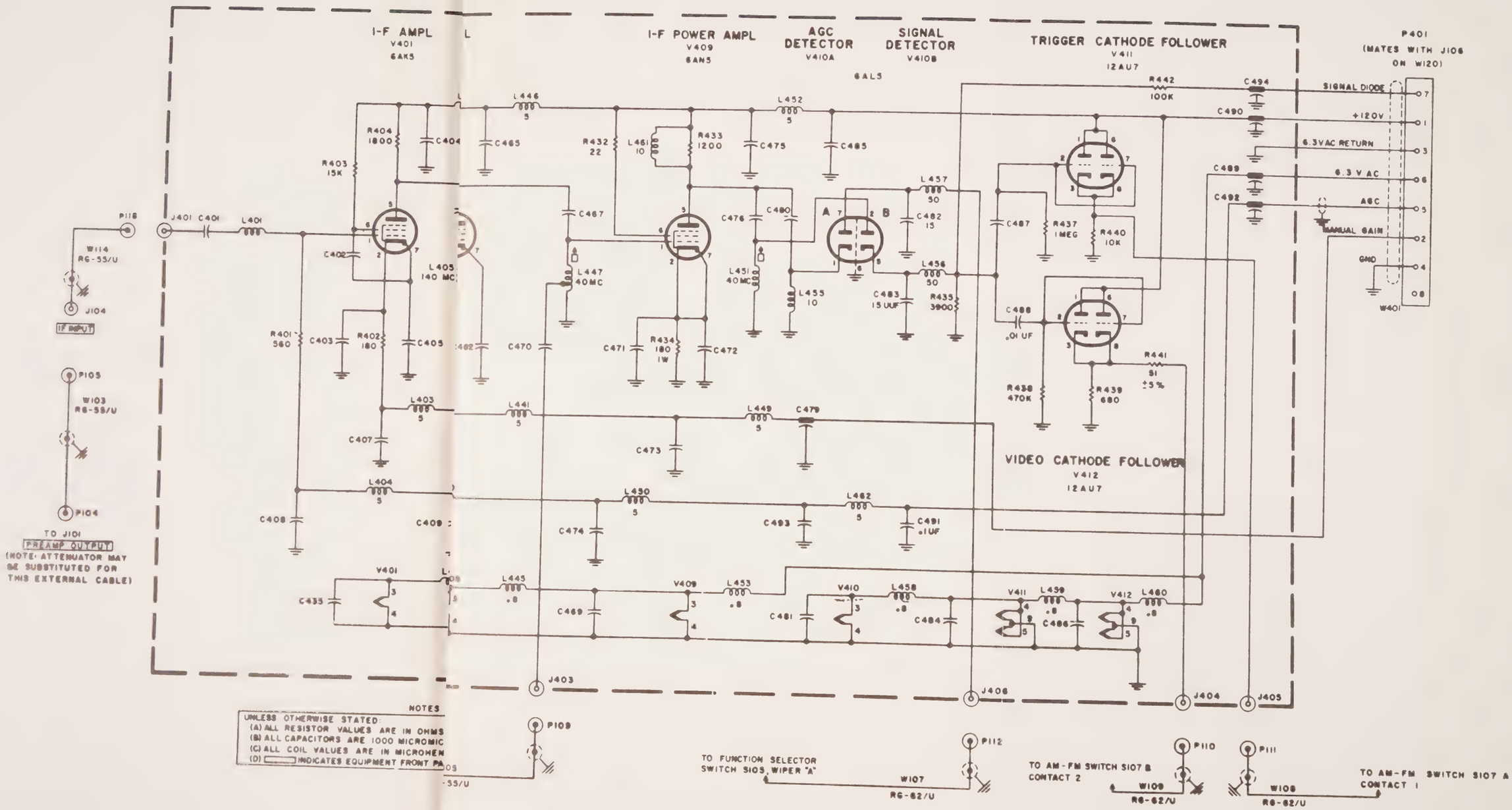


FIGURE 4-7. IF AMPLIFIER, SCHEMATIC DIAGRAM.

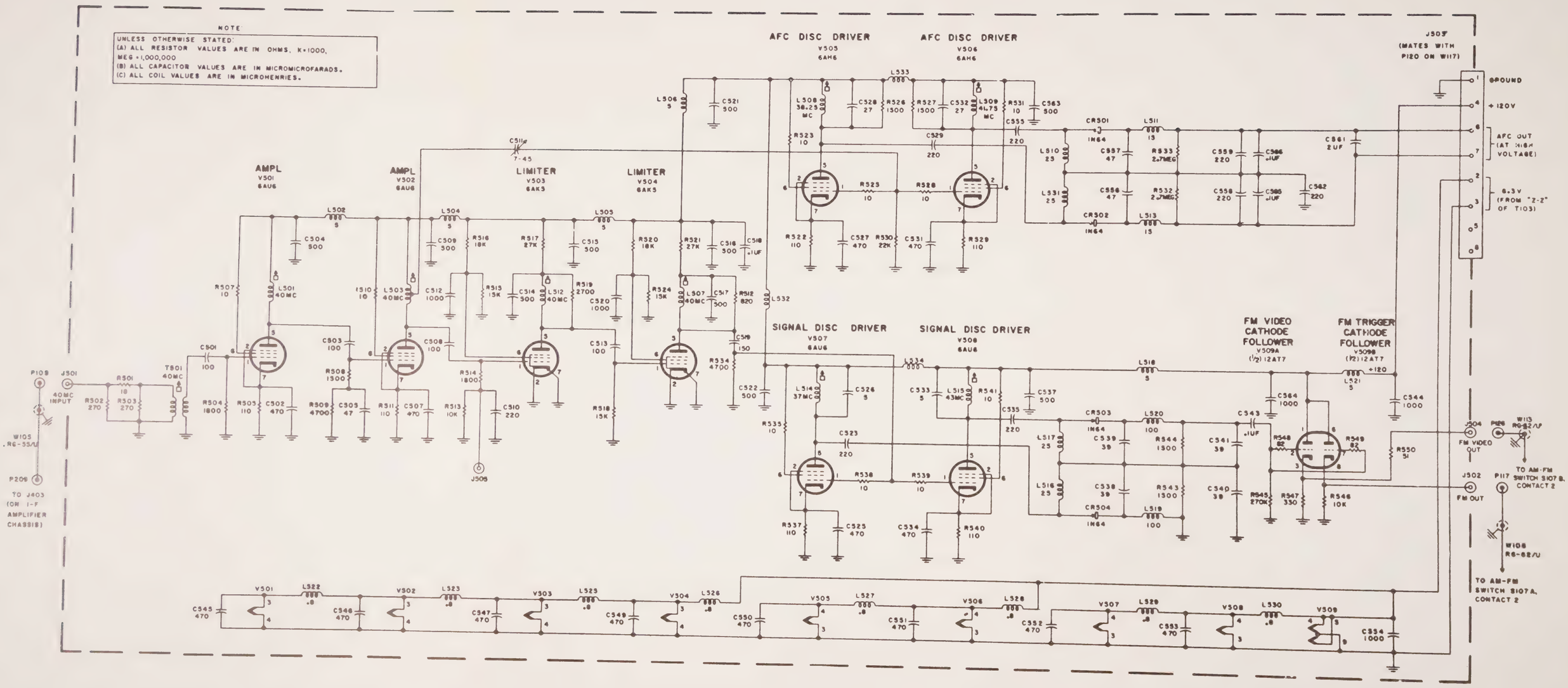


FIGURE 4-8. FM AMPLIFIER, SCHEMATIC DIAGRAM.

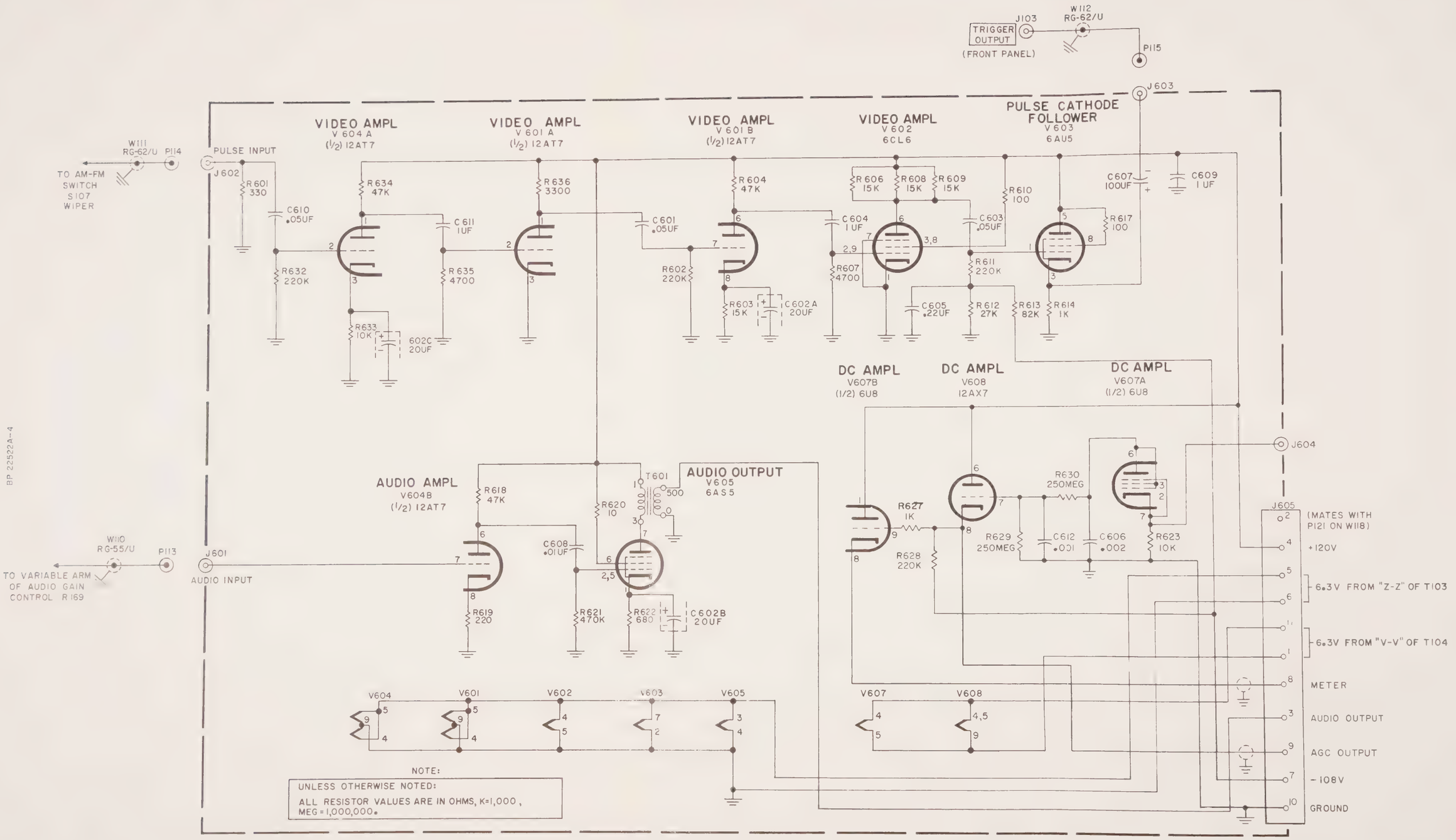


FIGURE 4-9. DETECTED SIGNAL AMPLIFIER, SCHEMATIC DIAGRAM.

DSK 222-0A
FOR SERIAL NOS. 1352 AND HIGHER

RECTIFIER
V101
5R4GY

SERIES REGULATOR
V103
807

VOLTAGE REFERENCE
V105
0A2

TO TUNING HEAD
P119
(MATES WITH J705, J805, J905, OR J1005)

S109 SHOWN IN 230V POSITION

S109
115V - 230V

T101

C101 2UF
C102 2UF
C103 2UF
C104 .5UF
C105 4UF
C106 2UF
C107 .5UF
C108 .1UF
C116 .1UF
C117 1UF

L101 30H 400Ω
L102 30H 800Ω

R101 47
R102 270K
R103 22K
R104 1MEG
R105 25K
ANODE V ADJ R109
R108 10K
R110 10K
R111 50K
R112 50K
R113 30K
R114 15K
R115 1.8K
R116 15K
R117 20K
R118 20K
R119 37.2
R120 47
R121 220K
R122 680K
R123 47K
R124 8200
R125 25K
REFLECTOR V ADJ
R126 35K
R127 470K
R128 20K
R129 3K
R130 5K
R131 500
R132 1MEG
R134 40K
R135 15K
R138 15K
R139 5K
R151 12.5
R152 68

RECTIFIER
V102
5R4GY

VOLTAGE CONTROL AMPL
V104
6AU6

RECTIFIER
V106
5R4GY

SERIES REGULATOR
V107
6AR6

VOLTAGE CONTROL AMPL
V108
6AU6

VOLTAGE REFERENCE
V109
0A2

AFC AMPL
V110
6AH6

AFC RELAY
K102

AFC S103 ON OFF

AFC ADJ

I-102
KLYSTRON

I-101
POWER

K103
HOLDING RELAY

K101
115 NO60
DELAY RELAY

T104

T102

115V
6V V1
6V V2

5V-2A
6.3V-1.5A
6.3V-.6A
6.3V-.3A

F102
5 AMP
F101
5 AMP

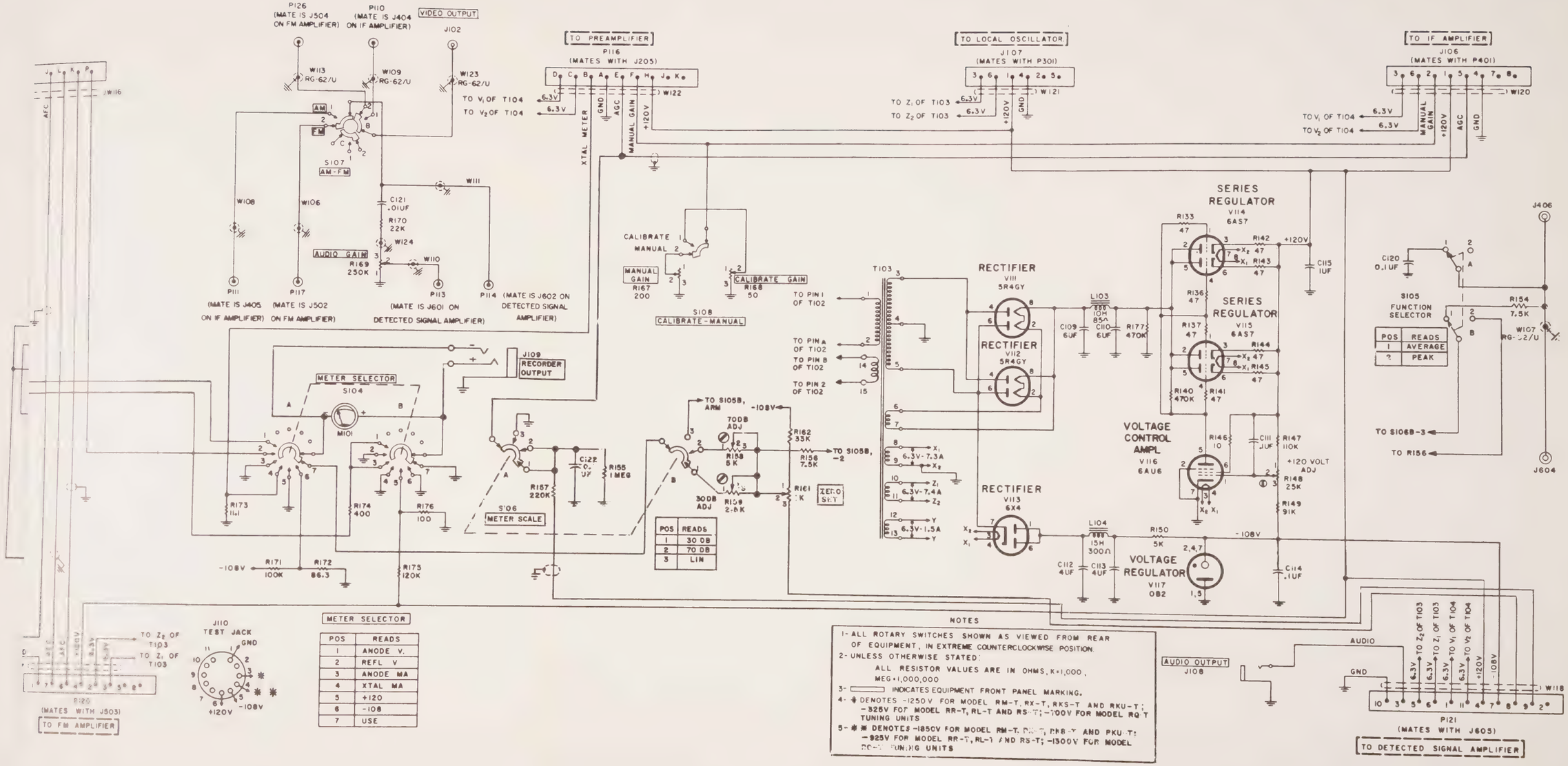
B101
MAIN BLOWER

P125
J111
P123
P124
J105
W115

S101
POWER
ON
OFF

-325V
115AC
115AC
AFC
6.3V
TO X1 OF T103
TO X2 OF T103
TO Y OF T103
TO Y OF T103

DSK 22104
FOR SERIAL NOS. 1352 AND HIGHER



NOTES

1- ALL ROTARY SWITCHES SHOWN AS VIEWED FROM REAR OF EQUIPMENT, IN EXTREME COUNTERCLOCKWISE POSITION.
2- UNLESS OTHERWISE STATED:
ALL RESISTOR VALUES ARE IN OHMS, K=1,000, MEG=1,000,000
3- [ ] INDICATES EQUIPMENT FRONT PANEL MARKING.
4- * DENOTES -1250V FOR MODEL RM-T, RX-T, RKS-T AND RKU-T; -325V FOR MODEL RR-T, RL-T AND RS-T; -700V FOR MODEL RQ-T TUNING UNITS
5- * * DENOTES -1850V FOR MODEL RM-T, RX-T, RKS-T AND RKU-T; -925V FOR MODEL RR-T, RL-T AND RS-T; -1300V FOR MODEL RQ-T TUNING UNITS

FIGURE 4-10. MAIN CHASSIS, SCHEMATIC DIAGRAM

POLARAD

PROVEN RELIABILITY

INSTRUCTION MANUAL

POLARAD MODEL R
MICROWAVE RECEIVER

R.F. TUNING HEADS

PART II

POLARAD ELECTRONICS CORPORATION
43-20 34th STREET • LONG ISLAND CITY 1 • NEW YORK, N. Y.

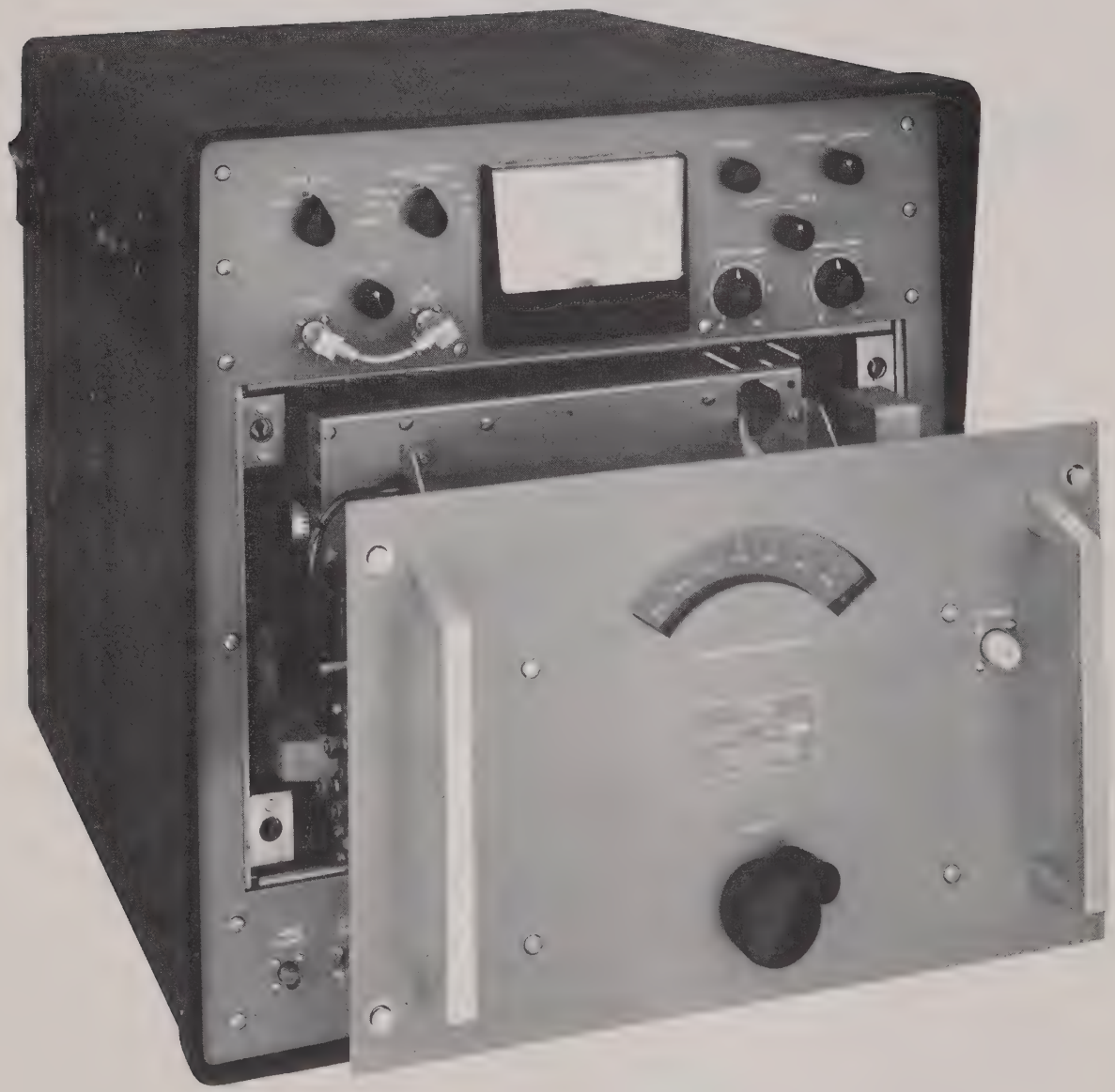


FIGURE 5-1. A TYPICAL RF TUNING UNIT, PARTIALLY WITHDRAWN FROM CABINET

SECTION V
GENERAL DESCRIPTION

1. INTRODUCTION.

a. TUNING UNITS - - Eight tuning units are available as part of the Model R Microwave receiver and provide continuous frequency coverage, in eight overlapping ranges, from 395 mc. to 46.7 kmc. Table 5-1 lists each tuning unit and its operating frequency range.

TABLE 5-1
TUNING UNITS FOR MODEL R MICROWAVE RECEIVER

Model	Operating Frequency Range
RR-T	395 mc - 1005 mc
RL-T	950 mc - 2040 mc
RS-T	1900 mc - 4340 mc
RM-T	4190 mc - 7720 mc
RX-T	7260 mc - 11,260 mc
RKS-T	9500 mc - 15,600 mc
RKU-T	14,700 mc - 22,000 mc
RQ-T	20,300 mc - 46,700 mc

b. GENERAL CONSTRUCTION - - With the exception of Models RKS-T, RKU-T and RQ-T, all models are similar, (see figure 5-1) containing an external cavity klystron local oscillator, a tracked preselector, a tracking potentiometer, a mechanical system to drive these components, and a preamplifier chassis. Models RKS-T, RKU-T and RQ-T contain all the aforementioned components, except the tracked preselector. These units use a bandpass filter in place of the tracked preselector.

c. TUNING - - All units are tuned manually by rotating a single TUNING knob, located at the bottom center of the equipment front panel. This drives a calibrated tuning dial. On units having the preselector, two cams are mounted on the tuning shaft; one tunes the preselector, the other tunes the klystron oscillator. On Models RKS-T, RKU-T and RQ-T only one cam is required in the absence of the tracked preselector. The preselector units are provided with two adjustment bars for fine adjustment of preselector to klystron frequency tracking. Each bar has adjustment screws along its axis for vernier adjustment of the preselector plungers over the tuning range. Should readjustment be required, see the maintenance section of this part of the Instruction Manual for alignment procedures recommended for setting the vernier screws.

2. ELECTRON TUBE COMPLEMENT.

Table 5-2 lists the electron tubes and crystal diodes used in each of the tuning units. The table also lists total numbers of tubes and diodes for each unit and all units combined.

TABLE 5-2
ELECTRON TUBE AND CRYSTAL DIODE COMPLEMENT

Unit	Number of Tubes and Crystal Diodes of Types Indicated																	TOTAL
	6BL6, 5836 or ZV1009	5837 or 6BM6, 2V1010	Sarkes-Tarzian M-500	1N21D	1N23C	1N26	1N53	1N78, 0979	1N286	5721	5876	6AK5	6X4	G7A	GL-6299	V39C	0B2	
RR-T		1	4	1							1	1	1	1	2		2	14
RL-T		1			1						1	1	1	1				6
RS-T	1				1						1	1	1	1				6
RM-T					1					1	1	1	1	1				6
RX-T								1		1	1	1	1	1				6
RKS-T									1	1	1	1	1	1				6
RKU-T									1	1	1	1	1	1				6
RQ-T						1	1				1	1	1	1		1		7
TOTAL	1	2	4	1	3	1	1	1	2	4	8	8	8	8	2	1	2	57

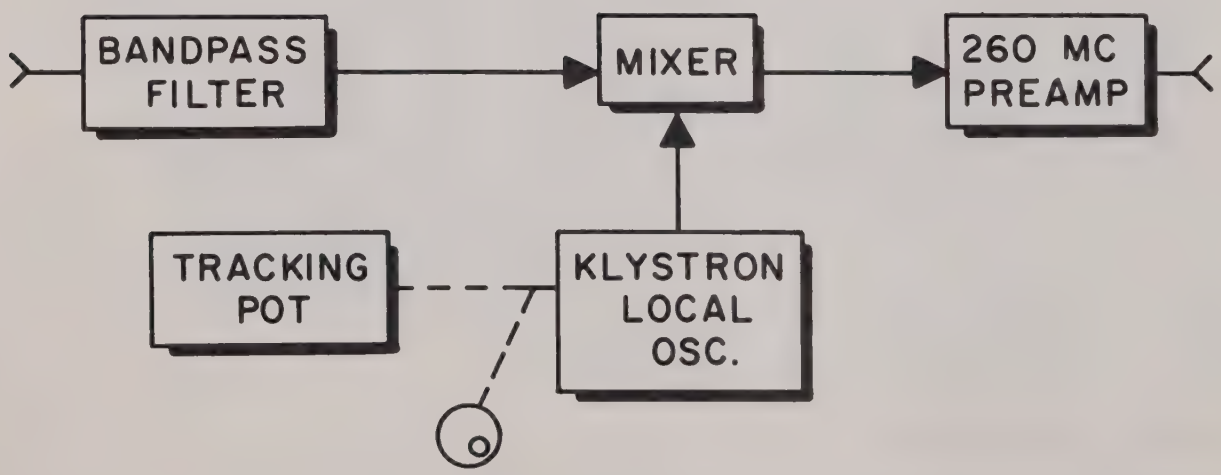


FIGURE 6-1. RKS-T AND RKU-T TUNING HEADS, BLOCK DIAGRAM

SECTION VI
THEORY OF OPERATION

1. GENERAL.

a. PURPOSE OF EQUIPMENT - - The Polarad Model R Microwave Receiver is a sensitive, high-frequency receiver designed for power and frequency measurements in the microwave frequency spectrum. In addition to providing comparative indications of power and frequency, the receiver permits audio, video, and recorder monitoring of microwave signals.

b. BLOCK DIAGRAMS - - Figure 2-1 in Part I of this Instruction Manual shows a block diagram of a typical RF Tuning Unit which employs a preselector (Models RR-T, RL-T, RS-T, RM-T and RX-T). Figure 2-1 of this part of the Instruction Manual shows a similar block diagram of Models RKS-T, RQ-T and RKU-T which have input bandpass filters in place of tuned preselectors.

(1) On units utilizing a preselector, (figure 2-1, Part I), the RF signal from the antenna is fed via the panel RF INPUT jack to the input of the preselector. This preselector is a tuned bandpass filter consisting of two coaxial cavity tuned circuits. After passing through the preselector, the signal is coupled to the first mixer, which uses a crystal diode. The output of the klystron local oscillator is also fed to the first crystal mixer. This local oscillator utilizes a klystron tube within a coaxial cavity resonator and tracks with the preselector through a mechanical drive system. The system is so designed that the frequency of the local oscillator, at any point within the frequency range, differs from the resonant frequency of the preselector by 260 mc. On units RR-T, RL-T, RS-T and RM-T the oscillator frequency is 260 mc higher than the preselector input signal. On units RX-T, RKU-T and RQ-T it is 260 mc lower. Therefore, a beat signal of 260 mc, produced at the output of the first crystal mixer, is fed to the first IF amplifier, mounted on the preamplifier chassis. This first IF amplifier is a pencil-triode type tube, connected as a grounded-grid amplifier. The amplified 260 mc output signal from the pencil-triode stage is fed to a second crystal mixer, which also receives a 120-mc output signal from a frequency-doubler stage, mounted on the crystal-controlled local-oscillator chassis. One of the beat signals at the output of the second crystal mixer is peaked by an RF transformer, pre-set to 140 mc, and is amplified by a miniature RF pentode tube, V202. The output of the second IF amplifier is coupled through an RF tuning coil, a blocking capacitor, a coaxial connector, and a type RG-55/U coaxial cable to the front panel PREAMP OUTPUT jack J101.

(2) On Models RKS-T and RKU-T, (figure 6-1, Part 2), the incoming signal is fed through a bandpass filter into the mixer. The system is designed to generate the second harmonic of the oscillator within the mixer where the RF signal and the second harmonic are heterodyned to produce the 260-mc IF signal. Thus the RF signal will be received when it is 260 mc above the second harmonic of the klystron oscillator frequency.

(3) Figure 6-2, Part 2 shows the block diagram of the Model RQ-T RF Tuning Unit. The RF signal from the antenna is fed via the front panel through one of the RF input jacks J1201 or J1202, depending upon the desired frequency, and coupled to the desired first crystal waveguide mixer. The frequency range of the first RF input is 20.3 to 26.5 kmc and the frequency range of the second is 26.5 to 40 kmc. A waveguide adapter is mechanically attached to the front panel waveguide connector, so that the range of the second waveguide input is extended from 40 to 46.7 kmc. The output of klystron local oscillator (varying between 10 and 15.5 kmc) is fed through a hybrid "T" network to the first crystal waveguide mixers, where second and third harmonics of the signal are generated. The klystron local oscillator tuning cavity tracks with its repeller voltage through a

mechanical drive system. The local oscillator frequency is 260 mc lower than the incoming frequency. The 260 mc IF at the output of the crystal waveguide mixers is fed through the preamplifier filter by means of a coaxial switch, to the first IF amplifier, which is mounted on the preamplifier chassis. The first IF amplifier is a pencil-triode type tube. The amplified 260 mc output signal from the pencil-triode stage is fed to the second crystal mixer, which is mounted on the preamplifier chassis. This mixer also receives a 120 mc output signal from a frequency doubler stage, which is mounted on the crystal-controlled local oscillator chassis on the basic Model R Receiver. (See Part I of this Instruction Manual.) The 120 mc signal at the output of the second crystal mixer is peaked by an RF transformer and is amplified by a miniature RF pentode tube, V202. The output of the second IF amplifier is coupled through an RF tuning coil, a blocking capacitor, a coaxial connector and a type RG-55/U coaxial cable to the front panel PREAMP OUTPUT jack J101.

2. RF PRESELECTOR, DETAILED DESCRIPTION.

a. INTRODUCTION - - On units where it is utilized, the preselector tracks with the klystron local oscillator tube over the entire frequency range. The two resonant circuits employed in the preselector yield both the desired bandwidth and the desired rejection of spurious signals. The two coaxial cavities, coupled by means of apertures, provide a minimum of a 60 db image rejection. The cavities operate as resonant lines and are tuned to the desired electrical length by rotation of the front panel TUNING knob.

b. MECHANICAL DRIVE SYSTEM - - The mechanical drive system for the preselector functions as described below:

(1) Mounted on the main drive shaft is the cam for the preselector drive, which converts rotation of the main tuning shaft to the translating motion required by the preselector. This cam drives a preselector follower, which causes the shaft and yoke of the preselector to move. The two movable plungers, which determine the electrical resonance of the preselector cavities, are mounted on the yoke.

(2) In addition to the direct drive system described above, a means of obtaining a small amount of correction to the motion of the plungers is provided. Mounted to the main drive shaft is a correcting gear, which mates with a correcting rack. This gear and rack assembly causes two channels to move in synchronism with the main drive shaft. Each channel contains a tape cam, the shape of which may be adjusted by means of a series of screws. A correcting mechanism is provided for each tape cam. Each correcting mechanism pushes against one of the preselector plungers. Therefore, each preselector plunger can be corrected independently. In this way, precise insertion of each plunger within its preselector cavity is obtained at all points within the tuning range.

(3) When shipped from the manufacturer, the tape cam adjustment screws are properly set to yield optimum tracking of the preselector with the klystron oscillator. (See par. 5, Section VIII, in this part of the Instruction Manual for re-adjustment procedures.)

3. CRYSTAL MIXER, DETAILED DESCRIPTION.

Incoming RF signals are passed through the preselector (Models RR-T, RL-T, RS-T, RM-T, RX-T) or bandpass filter, (Models RKS-T, RKU-T and RQ-T) and applied to the first mixer, a crystal diode. In addition, RF energy from the klystron local-oscillator is applied to the mixer crystal diode. The signal from the local-oscillator may be either the fundamental frequency or the second or third harmonic of the oscillator, depending upon the unit. In any event, the frequency of the fundamental or harmonic energy from the local-oscillator will always differ from the input RF signal by 260 mc. Due to the nonlinear characteristics of the crystal mixer, a

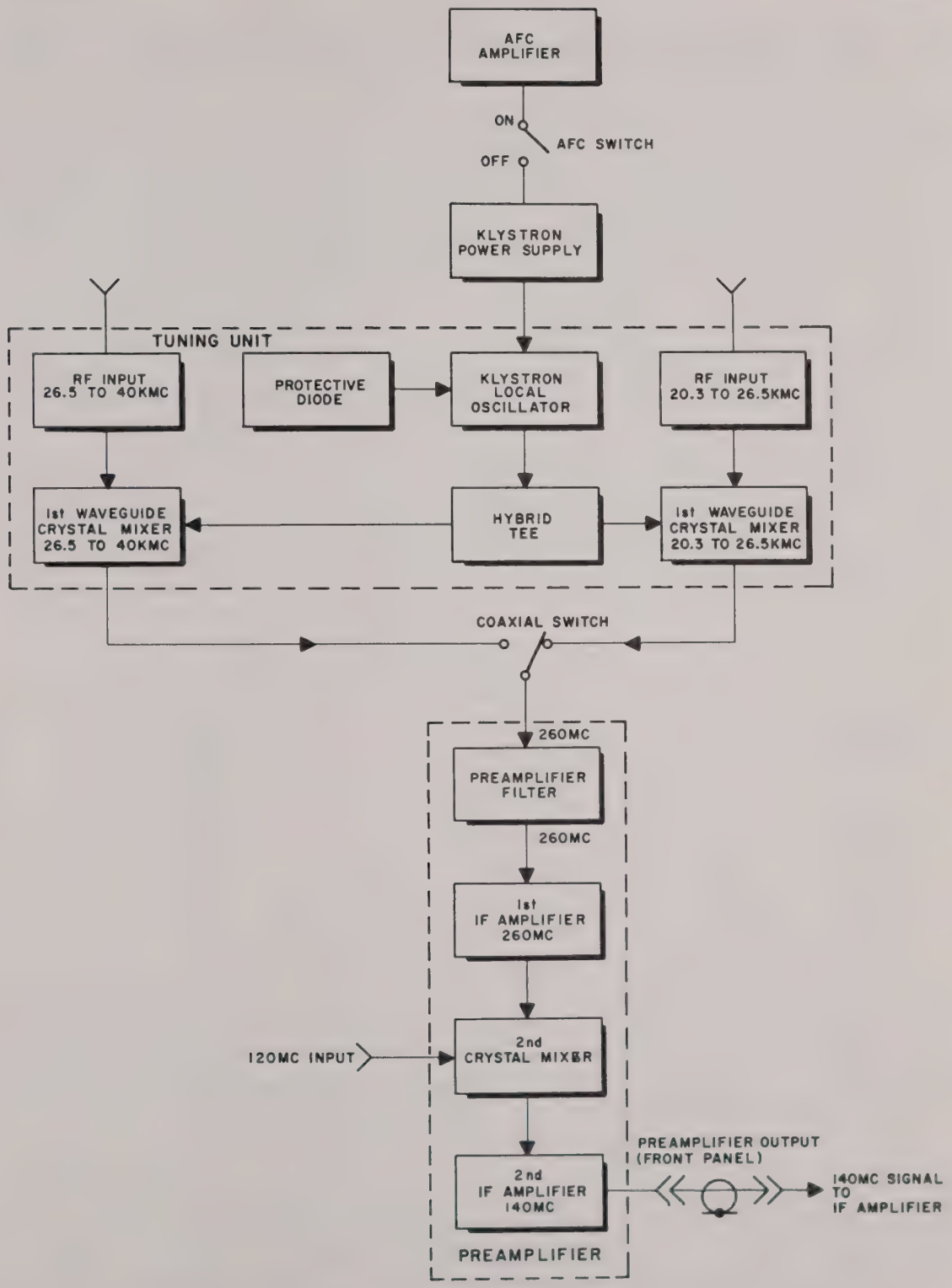


FIGURE 6-2. MODEL RQ-T RF TUNING UNIT, BLOCK DIAGRAM

beat frequency of 260 mc (the difference between the signal and local-oscillator frequencies) is produced. This 260-mc difference signal is fed via coaxial cable to input jack J206 on the preamplifier.

4. FIRST LOCAL OSCILLATOR, DETAILED DESCRIPTION.

a. GENERAL - - The local-oscillator uses a reflex klystron tube and a coaxial cavity resonator, external to the tube. The oscillator tunes continuously over the range necessary to supply correct mixer signals for the particular RF tuning unit. The resonator is tuned by means of a non-contacting short-circuiting plunger. The reflector voltage applied to the klystron tube is tracked with the movement of the plunger by means of a mechanical drive system and tracking potentiometer. Power is coupled from the resonator by a coupling at a fixed point in the cavity. The power available from the oscillator is delivered to the first crystal mixer, where it is mixed with the output from the preselector or input filter, depending upon the unit employed.

b. REFLEX KLYSTRON - - The first local-oscillator tube (V701, V801, V901, V1001, V1103 or V1201) is a klystron with an external resonator. The resonant cavity circuit connects to two electrodes which are termed "resonator grids". The resonator grids of the tubes are separated from the cathode by an accelerator grid, which speeds up the electrons drawn from the cathode. The repeller electrode, on the opposite end of the tube from the cathode, operates at a high negative potential so that it can repel the electron stream. (Table 6-1 lists the cathode voltages and repeller voltage ranges of each of the tuning units). The cathode voltages remain fixed. The repeller voltages vary within the indicated ranges as the klystrons are tuned.

TABLE 6-2
CATHODE AND REPELLER VOLTAGES

TUBE	UNIT	CATHODE VOLTAGE*	REPELLER VOLTAGE RANGE
V1103	RR-T	-325V	-325V to -925V
V701	RL-T	-325V	-325V to -925V
V801	RS-T	-325V	-325V to -925V
V901	RM-T	-1250V	-1250V to -1850V
V1001	RX-T	-1250V	-1250V to -1850V
V901	RKS-T	-1250V	-1250V to -1850V
V1001	RKU-T	-1250V	-1250V to -1850V
V1201	RQ-T	-700V	-700V to -1300V

*Measured with respect to ground.

c. KLYSTRON CAVITY - - The cavity employed is in the form of a coaxial transmission line, and consists of two cylinders, one inside the other. The klystron tube is inserted at one end of this line, so that the outer cylinder makes contact with the first interaction grid (so termed because it is closer to the cathode), while the inner cylinder makes contact with the second interaction grid. At the other end, the circuit is completed by a movable non-contacting shorting plunger of special construction. The position of this movable short determines the resonant frequency of the cavity.

d. REPELLER VOLTAGE TRACKING - - The frequency of oscillation of the klystron oscillator is determined by the resonant frequency of the cavity and by the magnitude of repeller voltage. For a given setting of the cavity, there is an optimum value of repeller voltage for maximum RF power. Therefore, the repeller voltage cannot be kept constant over the frequency range of the oscillator. In order to make the oscillator function over its wide frequency range, an arrangement is used to vary the dc voltage on the repeller so that repeller voltage

is maintained at the optimum value for the maximum amplitude of oscillation. In Units RX-T, and RKU-T a mode selector switch, S1001, is included in the repeller voltage control circuit, as described below.

e. MODE SWITCHING - - Models RX-T and RKU-T employ the 3-3/4 repeller mode over the local oscillator frequency ranges of 7,000 - 9,400 mc and 7220 - 9400 mc, respectively. At 9,400 mc it becomes advantageous to switch to the 4-3/4 repeller mode to obtain a more stable RF output. Changing repeller modes at a particular cavity setting is accomplished without changing the frequency of oscillation by lowering the repeller voltage so that the klystron oscillator operates in the desired 4-3/4 mode.

f. REPELLER VOLTAGE TRACKING CIRCUITS

(1) GENERAL - - The repeller voltage tracks with the tuning dial throughout the entire frequency range of a given tuning unit. Two types of repeller voltage tracking circuits are used, one where the tracking potentiometer alone provides the necessary voltage range (as in Models RR-T, RL-T, RS-T, RM-T and RKS-T) and the second, where a mode selector switch and relay are used in conjunction with the tracking potentiometer (as in Models RX-T, RKU-T and RQ-T.)

(2) Models RR-T, RL-T, RS-T, RM-T, RKS-T and RQ-T. On these tuning units, the dc voltage applied to the repeller is controlled by a wire-wound tracking potentiometer. (See Table 2-2 for applicable reference designations.) The arm of this potentiometer is mechanically ganged to the oscillator cavity choke. Values of resistors in the tracking circuit are selected to insure that the proper frequency-versus-voltage characteristic is obtained for the repeller electrode. A LOW ADJ. control, and a HIGH ADJ. control are provided on the potentiometer control panel. (See Table 6-2 for applicable reference designations.)

TABLE 6-2
TRACKING, POTENTIOMETER AND ASSOCIATED ADJUSTMENTS

TUNING UNIT	TRACKING POTENTIOMETER	LOW ADJ. POTENTIOMETER	HIGH ADJ. POTENTIOMETER
RR-T	R1110	R1111	R1108
RL-T	R705	R704	R709
RS-T	R805	R804	R809
RM-T	R905	R904	R908
RX-T	SEE TEXT BELOW		
RKS-T	R905	R904	R908
RKU-T	SEE TEXT BELOW		
RQ-T	R1207	R1208	R1204

(3) Models RX-T and RKU-T - - On Models RX-T and RKU-T, a tracking potentiometer, R1008, is driven in the same manner as on other units. In addition, mode switch S1001 is operated by a cam on the drive mechanism, and actuated at a dial frequency of 9660 mc in Unit RX-T or 19,060 mc in Unit RKU-T. The action of the cam changes the voltage applied to the tracking potentiometer as the tuning of the klystron oscillator is varied. This results in a change in repeller mode from 3-3/4 mode to 4-3/4 mode of operation. Values of resistors in the tracking circuit are selected to insure that the proper frequency-versus-voltage characteristic is obtained for the repeller electrode. TRACK 1 (TR1) R1010 and TRACK 2 (TR2) R1107 are potentiometers with slotted shafts which set the voltage applied to wire-wound potentiometer R1008. In addition LOW ADJ. controls R1005 and R1018 and HIGH ADJ. controls R1009 and R1020 are provided on the potentiometer control panel for proper setting of repeller voltages. Two LOW ADJ. and HIGH ADJ. controls are provided to separate low and high range adjustments in each mode.

5. PROTECTIVE DIODE, DETAILED DESCRIPTION.

All units are provided with a protective diode tube connected between the cathode and the repeller electrode of the klystron oscillator. (See Table 6-3 for applicable reference designations.) This diode is utilized to prevent the repeller of the klystron from going positive with respect to its cathode. Reference to the schematic circuit diagrams show that the cathode, pin 7, of the diode is connected directly to the cathode of the reflex klystron, to which the -325, -700, or -1250 volts (depending on unit used - See Table 6-3) is applied. Since the plates, pins 1 and 6, of the diode are directly connected to the repeller electrode of the klystron, any circuit disturbance causing the diode plates (or the repeller electrode) to become more positive than the correct negative potential will drive the protective diode into conduction. When the diode is in a conducting state, the maximum positive repeller voltage is the small drop across the diode.

TABLE 6-3
PROTECTIVE DIODES

UNITS	PROTECTIVE DIODE
RR-T	V1104
RL-T	V702
RS-T	V802
RM-T	V902
RX-T	V1002
RKS-T	V902
RKU-T	V1002
RQ-T	V1202

6. PREAMPLIFIER, DETAILED DESCRIPTION.

a. GENERAL - - The preamplifier receives signals from the first crystal mixer at a frequency of 260 mc, converts the signals to a lower IF of 140 mc, and amplifies this frequency. This 140 mc signal is applied to the input of the IF amplifier circuit within the basic instrument. On Models RR-T, RKS-T, RKU-T and RQ-T a preamplifier filter, figure 4-7, is electrically connected between the first crystal mixer and preamplifier. The filter is a 260 mc bandpass filter.

b. DETAILED FUNCTION - - The 260-mc signal from the first crystal mixer is applied via peaking coil L204 (L1120 on Model RR-T) to the cathode of a pencil triode. The pencil triode V201 (V1105 on Model RR-T) connected as a grounded-grid amplifier, amplifies the signals and couples them via IF transformer T201 (T202 in Model RR-T) to the input of second crystal mixer CR202 (CR1105 in Model RR-T). Also applied to the input of the second crystal mixer is the 120 mc signal from the crystal-controlled local-oscillator chassis. As a result of heterodyning the 260 mc signal against the 120 mc signal, a 140 mc signal is coupled to IF transformer T202 (T1104 in Model RR-T) and is applied to the input of the impedance matching stage, V202 (V1106 in Model RR-T). Output at the plate of tube V202 (V1106) is coupled via RF choke L213 (L1130 in Model RR-T) and capacitor C225 (C1141 in Model RR-T) to coaxial connector J203 (J1111 in Model RR-T). Coaxial cable W102 applies the 140 mc signal to the PREAMP OUTPUT jack J101, mounted on the equipment front panel. Coaxial cable W103, supplied with the equipment, functions as a jumper between the front panel PREAMP OUTPUT jack J101 and the IF INPUT J104. For accurate comparisons of signals, an external calibrated attenuator may be used as a substitute for coaxial cable W103. (See Part I, Section III, of this handbook for operating instructions.) The 140 mc signal is applied to the IF Amplifier where further amplification and

frequency conversion take place. (For signal tracing within the IF Amplifier, refer to Part I, Section II, of this Instruction Manual).

c. MANUAL GAIN AND AGC CIRCUITS - - With the front panel CALIBRATE - MANUAL control rotated to its MANUAL position, the cathode resistance of the second IF preamplifier tube, V202 (V1106 in Model RR-T) may be varied with the front panel "Meter Scale Switch" rotated to either its 30 db or 70 db position, automatic gain control voltage is applied to the control grids of both the first and second preamplifier tubes, in the presence of strong signals. On Model RR-T the front panel "Function-Selector" rotated to either its IF or PULSE AGC position provides the same AGC action for this unit.

SECTION VII
INSTALLATION & OPERATION

1. GENERAL.

a. In general, the installation and operation procedures for each of the tuning units are similar, with minor differences appearing in the initial cabling procedures.

b. The Tuning Unit is shipped either installed in a Model R Receiver, or packed in a separate shipping case. In either case, the Tuning Unit is ready for use. Observe the usual precautions for unpacking a delicate instrument.

c. Inspect the interior of the equipment. Check to make sure that all tubes are firmly seated in their sockets, that all tube shields are properly in place, and that all interunit cabling connections are firm and secure.

CAUTION

Do not tamper with the Klystron oscillator cavity or any of the associated tracking mechanism as this has been carefully adjusted at the factory.

2. WAVEGUIDE ADAPTERS.

a. Tuning Unit Models RKS-T, RKU-T and RQ-T are supplied with waveguide adapters to match associated equipment into the waveguide inputs. Extreme care should be exercised in matching the correct flange of the waveguide adapters to the input of the Tuning Units as any mismatch will cause abnormal operation.

b. The RKS-T Tuning Unit is employed when coupling the tuning head to an RG-52/U waveguide and the CP902 adapter when coupling to an RG-91/U waveguide. Note that the thick, square flange of the CP901 waveguide adapter is mated to the WR-75 input of the tuning unit and that the thin flange is attached to the RG-52/U waveguide. The reverse of this procedure is followed when the CP902 waveguide adapter is used to furnish a matching coupling to an RG-91/U waveguide. In this instance, the thin flange of the CP902 waveguide adapter is attached to the WR-75 input waveguide of the tuning unit and the thick, square flange is mated to the RG-19/U waveguide.

c. The RKU-T Tuning Unit is furnished with waveguide adapters CP1001 and CP1002. The CP1001 adapter is employed when coupling to an RG-91/U waveguide and the CP1002 adapter when coupling to an RG-53/U. Both adapters have a flange that fits the WR-51 waveguide input of the tuning unit. Hence, when the CP1001 adapter is used, the smaller flange is attached to the WR-51 waveguide input of the tuning unit and the larger flange is attached to RG-91/U waveguide. This procedure is reversed when the CP1002 waveguide adapter is used to furnish matching coupling to an RG-53/U waveguide. In this case, the larger flange is attached to the WR-51 waveguide input of the tuning unit and the smaller flange is mated to the RG-53/U waveguide.

d. The RQ-T Tuning Unit is furnished with waveguide adapter CP1201. The adapter is employed when coupling an RG-96/U waveguide to the RG-97/U supplied with the Tuning Unit.

3. INSTALLATION.

a. To install the tuning unit into the basic instrument, perform the following steps:

CAUTION

Before attempting to install the Model RS-T RF Tuning Unit into the basic instrument, be sure to rotate the tuning dial to 2400 mc or above. Removal is accomplished in the same manner.

(1) Pull out the Tuning Unit slides, located in the front panel opening of the basic unit, to their maximum extension.

(2) Place the Tuning Unit on the slides, making sure that the two slide locating screws are properly seated in their slots.

(3) Connect all interconnecting cables in accordance with Table 7-1.

(4) Slide the Tuning Unit into the space provided at the front of the basic instrument.

(5) Secure the Tuning Unit to the basic instrument by means of the four captive fasteners, located at the corners of the Tuning Unit front panel.

b. To remove a Tuning Unit from the cabinet perform the steps listed above in reverse order.

4. OPERATING CONTROL.

a. Control of a Tuning Unit is exercised by a simple knob control designated TUNING. This control is located in the center of the Tuning Unit front panel, and performs the following functions:

(1) When rotated, this control changes the position of the above assembly located within the oscillator cavity, thereby resonating the cavity to the desired wavelength mode.

(2) Changes the frequency of the plungers within the preselector chambers, thereby resonating the cavities to the frequency of the applied RF signal. (For Model RQ-T, the spurious mode suppressor pin in the oscillator cavity is driven.)

(3) Changes the position of the variable arm of the tracking potentiometer which determines the dc voltage applied to the reflector electrode of the klystron tube at a particular tuning dial setting.

(4) Drives the tuning dial

5. OPERATION.

For operating instructions, refer to Part I, Section III, of this Instruction Manual.

TABLE 7-1
INTERCONNECTING CABLES

Tuning Unit(s)	Cable	Plug	Connect to Jack	Located On
RR-T	W101	P101	J1110	Preamplifier
	W102	P103	J1111	Preamplifier
	W122	P116	J1114	Preamplifier
	W112	P119	J1115	Main Frame of Tuning Unit
RL-T	W101	P101	J202	Preamplifier
	W102	P103	J203	Preamplifier
	W122	P116	J205	Preamplifier
	W116	P119	J705	Main Frame of Tuning Unit
RS-T	W101	P101	J202	Preamplifier
	W102	P103	J203	Preamplifier
	W122	P116	J205	Preamplifier
	W116	P119	J805	Main Frame of Tuning Unit
RM-T	W101	P101	J202	Preamplifier
	W102	P103	J203	Preamplifier
	W122	P116	J205	Preamplifier
	W116	P119	J905	Main Frame of Tuning Unit
RX-T	W101	P101	J202	Preamplifier
	W102	P103	J203	Preamplifier
	W122	P116	J205	Preamplifier
	W116	P119	J1005	Main Frame of Tuning Unit
RKS-T	W101	P101	J202	Preamplifier
	W102	P103	J203	Preamplifier
	W122	P116	J205	Preamplifier
	W116	P119	J905	Main Frame of Tuning Unit
RKU-T	W101	P101	J202	Preamplifier
	W102	P103	J203	Preamplifier
	W122	P116	J205	Preamplifier
	W116	P119	J1005	Main Frame of Tuning Unit
RQ-T	W101	P101	J202	Preamplifier
	W102	P103	J203	Preamplifier
	W122	P116	J205	Preamplifier
	W116	P119	J1208	Main Frame of Tuning Unit

SECTION VIII

MAINTENANCE AND ALIGNMENT PROCEDURES

1. GENERAL.

a. This section of the Instruction Manual covers corrective maintenance procedures for the Polarad RF Tuning Units. Included are the alignment procedures which may be required to restore the instrument to peak operating efficiency, following maintenance and repair. In general, coverage applies to the following circuits:

(1) First Local Oscillator
(2) Preselector
(3) Crystal Mixer
(4) Preamplifier

b. Differences existing between Tuning Units are covered under each maintenance procedure. Unless otherwise specified, all procedures will apply to each model of the Tuning Unit.

2. TROUBLESHOOTING.

a. MECHANICAL

(1) The Mechanical drive system employed in any model of the Tuning Units should not be tampered with unless a mechanical breakdown occurs. Mechanical readjustment should be made only as a last resort and then only by thoroughly competent personnel. When readjustment in the mechanical drive system is required for electrical reasons, proceed as directed in paragraphs 3 through 5 of this section.

(2) Do not tamper with the klystron tube cavity or any of its associated mechanisms, unless the trouble is definitely isolated to the klystron tube. Replacement of the klystron tube involves considerable time in readjusting the mechanical tracking mechanism.

b. ELECTRICAL

(1) If the Model R Microwave Receiver exhibits improper functioning or reduced sensitivity, localize the trouble either to the Basic Unit or to the Tuning Unit. One method by which this can be done is to replace the existing Tuning Unit with one of the other Tuning Units covering a different frequency range. If the Receiver now performs satisfactorily, the trouble has been localized to the Tuning Unit. If the receiver still performs unsatisfactorily, the trouble most likely will be found in the Basic Unit.

(2) In the event that a second Tuning Unit is not available, perform a check of the main equipment operation, using the methods described in Part I, Section IV, Paragraphs 6c and 7c.

(3) Once the trouble has been localized to the Tuning Unit, perform a check of the sensitivity through the Preamplifier, as described below.

(4) Check for proper voltage and current readings on the panel-mounted meter. Insufficient crystal current may require replacement of the first crystal mixer.

3. FIRST LOCAL OSCILLATOR, TUBE REPLACEMENT AND BIAS SETTING.

a. GENERAL REPLACEMENT OF KLYSTRON OSCILLATOR TUBES (See figures 8-1 and 8-2)

(1) The reflex klystron oscillator tubes used with the Tuning Units listed in Table 8-1 are all replaced similarly. The tube is partially seated within the right end of the oscillator cavity. Its base is covered by a protective shield. (The procedure for Tuning Unit Model RQ-T is covered separately in paragraph 3.b. below.)

TABLE 8-1
KLYSTRON TUBES ASSOCIATED WITH TUNING UNITS

Tuning Unit Model	Klystron Tube Type
RL-T, RR-T	5837, 6BM6, ZV1010
RS-T	5836, 6BL6, ZV1009
RM-T	5721, 6236
RX-T, RKS-T, RKU-T	5721

(2) If replacement of the oscillator tube becomes necessary, proceed as directed below:

(a) BE SURE TO TURN OPERATING POWER OFF. Throw the POWER switch to its OFF position and remove the power input cable from the rear of the equipment.

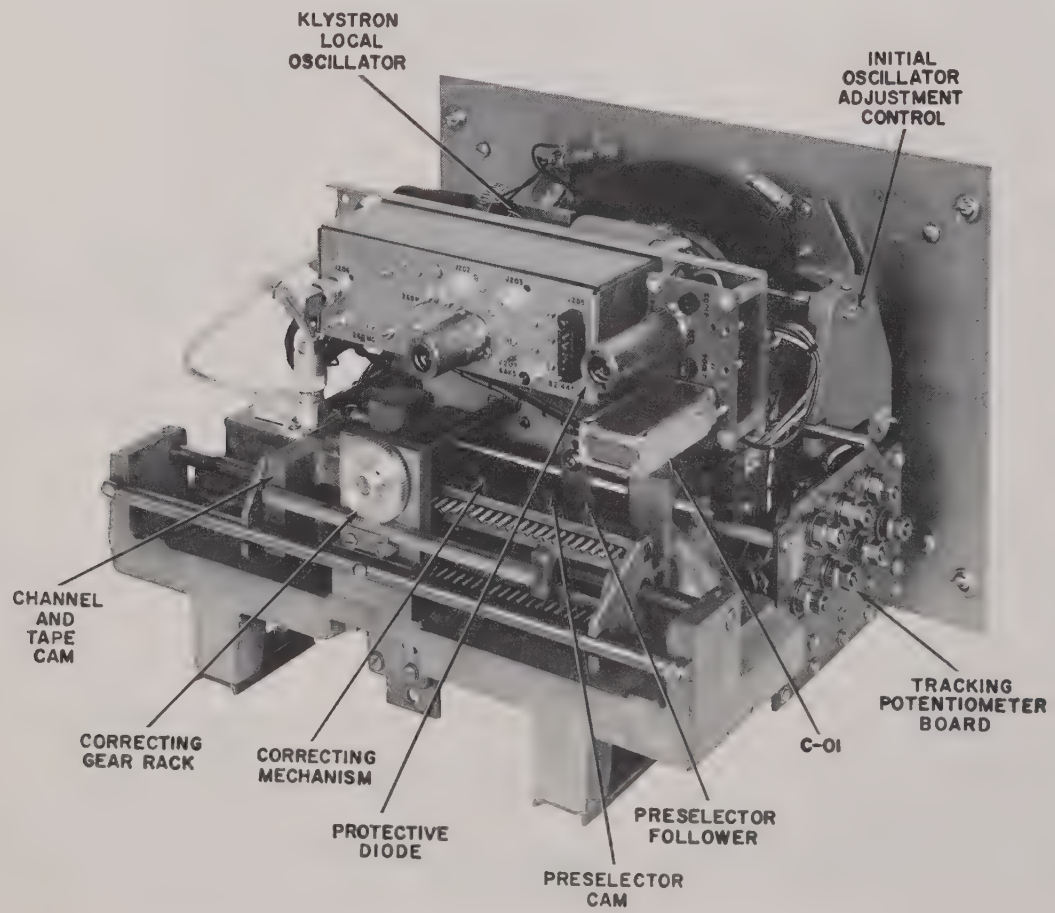


FIGURE 8-1. TYPICAL TUNING UNIT, RIGHT REAR VIEW

CAUTION

(MODEL RS-T TUNING UNIT ONLY)

Be sure to rotate the tuning dial of the Model RS-T Tuning Unit to 2400 mc or higher, before attempting to install (or remove) the unit into (or from) the basic instrument.

(b) Loosen the four captive fasteners, located at the corners of the Tuning Unit front panel, which retain the Tuning Unit within the equipment cabinet. The Tuning Unit may be withdrawn from the front of the cabinet enough to expose the oscillator cavity.

(c) Loosen the single screw which clamps the protective shield to the right end of the oscillator cavity. Remove the shield so that the tube socket and cavity are accessible.

(d) Gently pull the tube socket assembly away from the base of the klystron tube.

(e) Use a spanner wrench to loosen the knurled collar at the end of the cavity. DO NOT REMOVE THE COLLAR COMPLETELY.

(f) Grasp the projecting end of the klystron tube, gently rotating it in a clockwise direction, while simultaneously withdrawing the tube from the spring holders within the cavity.

(g) Disconnect reflector lead from tube.

NOTE

If the projecting end of the tube cannot be grasped securely, it may be necessary to remove the large knurled collar at the end of the cavity. In removing the collar, two springs, a washer and a retaining ring, mounted within the cavity, may also come out. Be sure to reinsert these components within the cavity. First, insert one spring; then follow with the washer, the other spring, and then the retaining ring. Replace the collar by threading it approximately 1/2 turn on to the cavity. Tuning head RR-T, RL-T and RS-T will have only one spring.

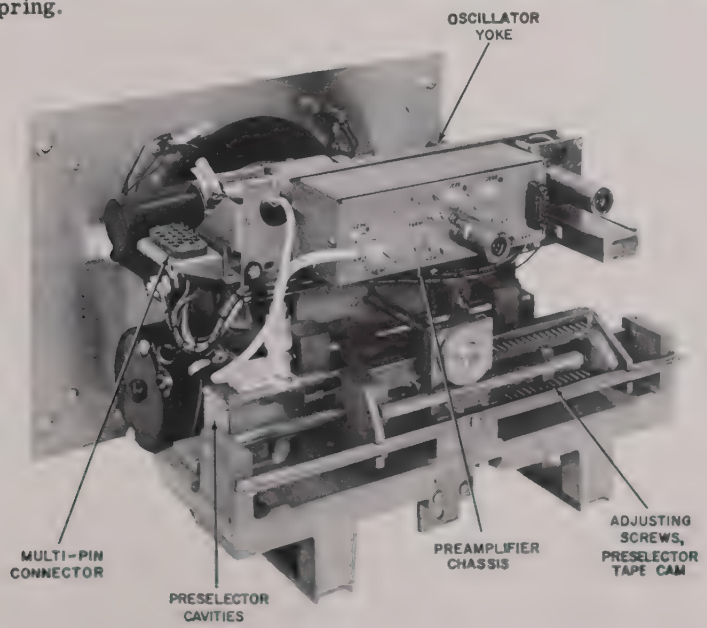


FIGURE 8-2. TYPICAL TUNING UNIT, LEFT REAR VIEW

(3) To insert a replacement tube into the cavity, proceed as directed below:

(a) Gently push the klystron tube into the center of the cavity, and press it all the way in, against a noticeable resistance. (This resistance is an indication that the inner conductors of the cavity are sliding over the collar at the end of the tube.) Continue pushing the tube into the cavity, giving the tube a slight clockwise twist, until it meets a positive stop, in the forward direction.

(b) Retighten the knurled collar at the right end of the cavity.

(c) Attach the socket assembly to the base of the replacement klystron tube.

NOTE

Carefully observe the arrangement of the four pins at the base of the tube, and the mating connectors on the tube socket. Do not use excessive force in replacing the socket assembly on to the base of the tube. It is possible to insert the socket in a misaligned position. The klystron oscillator will be inoperative under this condition.

(d) Replace the protective shield over the protruding socket of the tube, using the screw loosened in (2), (c), above, to secure the shield to the cavity.

b. GENERAL REPLACEMENT OF KLYSTRON OSCILLATOR TUBE IN TUNING UNIT MODEL RQ-T (See figures 8-3 and 8-4)

(1) A Varian type V39C is used as the reflex klystron oscillator within the Model RQ-T RF Tuning Unit. The klystron tube is seated near the right end of the oscillator cavity with its reflector cap towards the front panel and its base towards the rear panel. Its base and reflector cap are covered by protective shields. If replacement of the oscillator tube becomes necessary, proceed as directed below:

(a) BE SURE TO TURN OPERATING POWER OFF. Throw the POWER switch to its OFF position and remove the power input cable from the rear of the equipment.

(b) Set the TUNING dial to the extreme low frequency end (20.3 kmc)

(c) Loosen the four captive fasteners, located at the corners of the Tuning Unit front panel, which retain the Tuning Unit within the equipment cabinet. The Tuning Unit may now be withdrawn from the front of the cabinet far enough to expose the oscillator cavity.

(d) Remove the first WR75 waveguide section attached to the oscillator cavity by removing the four screws which tie it to the cavity and the four screws which connect it to the second WR75 waveguide section.

(e) Remove the two nuts which hold the clamping plate for the reflector protective shield. Remove the clamping plate and the protective shield so that the reflector cap is accessible.

(f) Gently remove the reflector cap from the klystron tube.

(g) Remove the two nuts which hold the clamping plates to the base protective shield. Remove the clamping plate and the tube base protective cover so that the tube socket is accessible.

(h) Loosen the two 0-80 klystron tube clamping screws which are located on the top and bottom of the cavity, directly above and below the klystron tube. The top screw is accessible through a clearance hole in the suppressor pin yoke and the bottom screw is accessible from below, through a clearance hole in the tuning head casting.

(i) Remove the four cap screws which hold the right end section of the cavity to the main cavity assembly. Grasp the base end of the klystron tube, to prevent it from falling while carefully removing the right end section of the cavity.

(j) Remove the klystron tube.

(k) Gently pull the tube socket assembly away from the base of the klystron tube.

CAUTION

In performing the following steps, care must be taken to prevent damage to the suppressor pin due to the motion of the suppressor yoke.

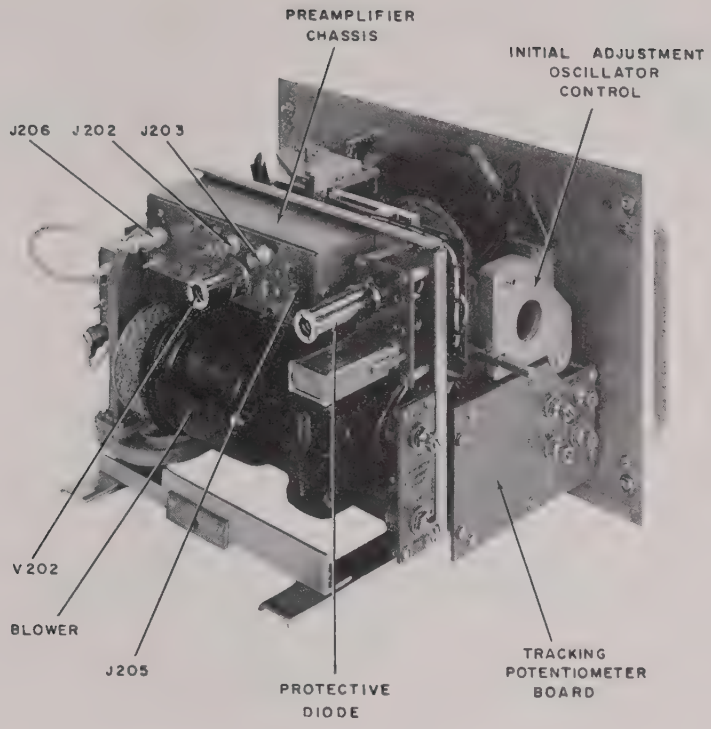


FIGURE 8-3. MODEL RQ-T RF TUNING UNIT, RIGHT REAR VIEW

(2) To insert a replacement type V39C tube into the cavity, proceed as directed below:

NOTE

The two wire gasket rings should be replaced whenever the klystron tube is removed from the cavity. They should be made of Number 16(50.82 mil diameter) solid base copper wire, 2-5/32 inches long.

(a) Connect the tube socket to the klystron tube base.

(b) Place the klystron tube in position with its positioning flange flush with the back of the cavity and the output window (small window) facing the right side of the cavity. The wire gasket ring towards the front panel should have its open section up and the gasket ring towards the rear plate should have its open section down.

(c) Gently position the right end section of the cavity over the klystron tube. If necessary, gently rotate the klystron tube so that the output window is perpendicular to the walls of the waveguide.

(d) Tighten the four cap screws which hold the right end section to the cavity; making sure that the right end section is perfectly flush to the cavity.

(e) Replace the tube base protective shield.

(f) Place the clamping plate in position and lock down with the two nuts which fasten it to the clamping plate studs.

(g) Connect the reflector cap to the klystron tube.

CAUTION

Tightening the screws too much will damage the klystron tube.

(h) Replace the reflector cap protective shield.

(i) Place the clamping plate in position and lock down with the two nuts which fasten it to the clamping plate studs.

(j) Replace the two 0-80 klystron clamping screws. Tighten the screws until snug.

(k) Replace the first waveguide section with the four screws which hold it to the cavity and the four screws which connect it to the second waveguide section.

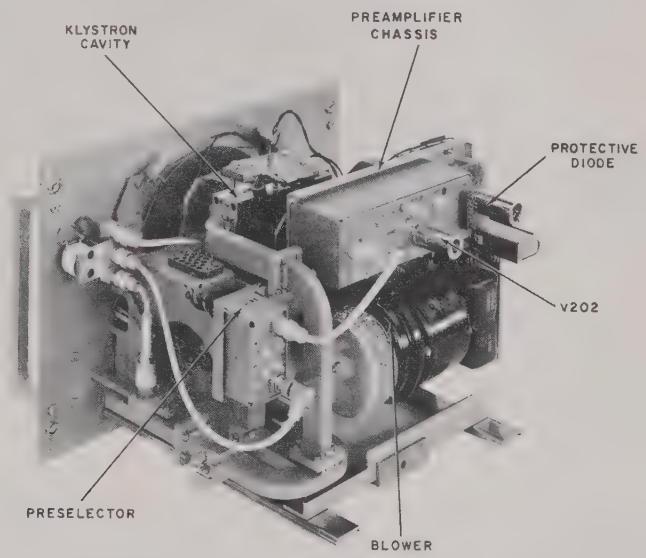


FIGURE 8-4. MODEL RQ-T RF TUNING UNIT, LEFT REAR VIEW

c. BIAS ADJUSTMENT - - Bias adjustment procedures are performed in all Tuning Units except Model RQ-T. Differences in the adjustment procedures for the different Tuning Units are indicated below:

WARNING

In performing the following steps, maintenance personnel must be constantly aware of the high voltages existing at various points on the Tuning Unit. Before making any meter connection or chassis adjustment, remove operating power from the equipment. If it is necessary to work with an energized equipment, be sure to use high-voltage insulating gloves and well-insulated tools. Exercise extreme caution at all times.

(1) Before applying power to the Tuning Unit, it will be necessary to readjust the BIAS ADJ potentiometer on the potentiometer control panel located on the left side of the Tuning Unit. This panel is accessible when the Tuning Unit is withdrawn partially from the main equipment cabinet.

(2) The following bias procedures apply to Tuning Unit Models RL-T and RS-T only. Follow the step by step procedures, as directed below.

(a) Unlock the shaft of the BIAS ADJ potentiometer and rotate its arm to its extreme counter-clockwise position.

(b) Use a Simpson Model 212 voltmeter, or equivalent, to set the bias voltage between cathode and grid of the klystron tube. These circuit points are accessible on a terminal strip (See Figure 8-1) located directly above the tracking potentiometer board. The cathode lead is labeled "K"; the grid lead is labeled "G". Secure the voltmeter test probes to the proper terminals on the terminal strip.

(c) Connect the power cable to the receptacle at the rear of the equipment, and turn the POWER switch to its ON position. Allow a ten-minute warm up period.

(d) Vary the arm of the BIAS ADJ potentiometer to obtain a pointer deflection on the external voltmeter of 10 volts positive. After satisfactory adjustment has been completed, lock the shaft of the potentiometer. When a 6BM6 klystron is used in the RR-T, RL-T and RS-T Tuning Heads, use step 3 (a) below.

(3) The following bias procedures apply to Tuning Unit Models RR-T, RM-T, RX-T, RKS-T, RKU-T only.

(a) Unlock the shaft of the BIAS ADJ potentiometer, and rotate its arm to its extreme counterclockwise position.

(b) Set the METER SELECTOR to the ANODE MA position.

(c) Connect the power cable to the receptacle at the rear of the equipment and turn the POWER switch to its ON position. Allow a ten-minute warm-up period.

(d) Vary the arm of the BIAS ADJ potentiometer until the meter pointer is deflected to the numeral 5 on linear red scale.

(e) After a satisfactory adjustment has been made, lock the shaft of the potentiometer.

d. REFLECTOR VOLTAGE TRACKING ADJUSTMENTS

(1) Due to variations in klystron tube characteristics, replacement of the klystron tube within any one of the Tuning Units will usually require readjustment of reflector voltages. To perform these adjustments, proceed as follows for all Tuning Unit Models:

(a) Set up a meter to monitor the reflector supply voltage, as directed in Section IV, Paragraph 4b, in Part I of this Instruction Manual. Readjust REFLECTOR V ADJ control R125 to maintain a meter pointer deflection of 600 volts during the following adjustment procedure.

(b) Remove the cable plugged into input jack J206, (input jack J1106, Model RR-T only). Connect the cable to the vertical input of a high gain oscilloscope, such as a Dumont Model 304 or equivalent, as shown in figure 8-5.

(c) Set up the modulating circuit shown in figure 8-5. Connect the output leads from the 1:2 step-up transformer to the appropriate jacks located on the diode board. Table 8-2 lists the cable numbers and the diode board jacks associated with each Tuning Unit Model. Connect the output leads of the other transformer to the horizontal input of the scope, to give an appropriate trace. Set the Modulation Amplitude control to its extreme counterclockwise position.

TABLE 8-2
CABLE AND JACK NUMBERING

Tuning Unit Model	Cable Number	Diode Board Jack Numbers
RL-T	W702	J703, J704
RS-T	W802	J803, J804
RM-T, RKS-T	W902	J903, J904
RX-T, RKU-T	W1002	J1003, J1004
RR-T	W1102	J1119, J1120
RQ-T	W1202	J1203, J1204

(d) Turn the Model R Receiver POWER switch to its ON position and allow a ten-minute warm-up. Do not change the setting of the BIAS ADJ potentiometer, since the beam current has been properly adjusted by following the directions previously given above.

(e) Adjust the Modulation Amplitude control until the sides of the klystron mode trace are visible on the oscilloscope screen. Adjust the Phase Shift control to superimpose the two traces.

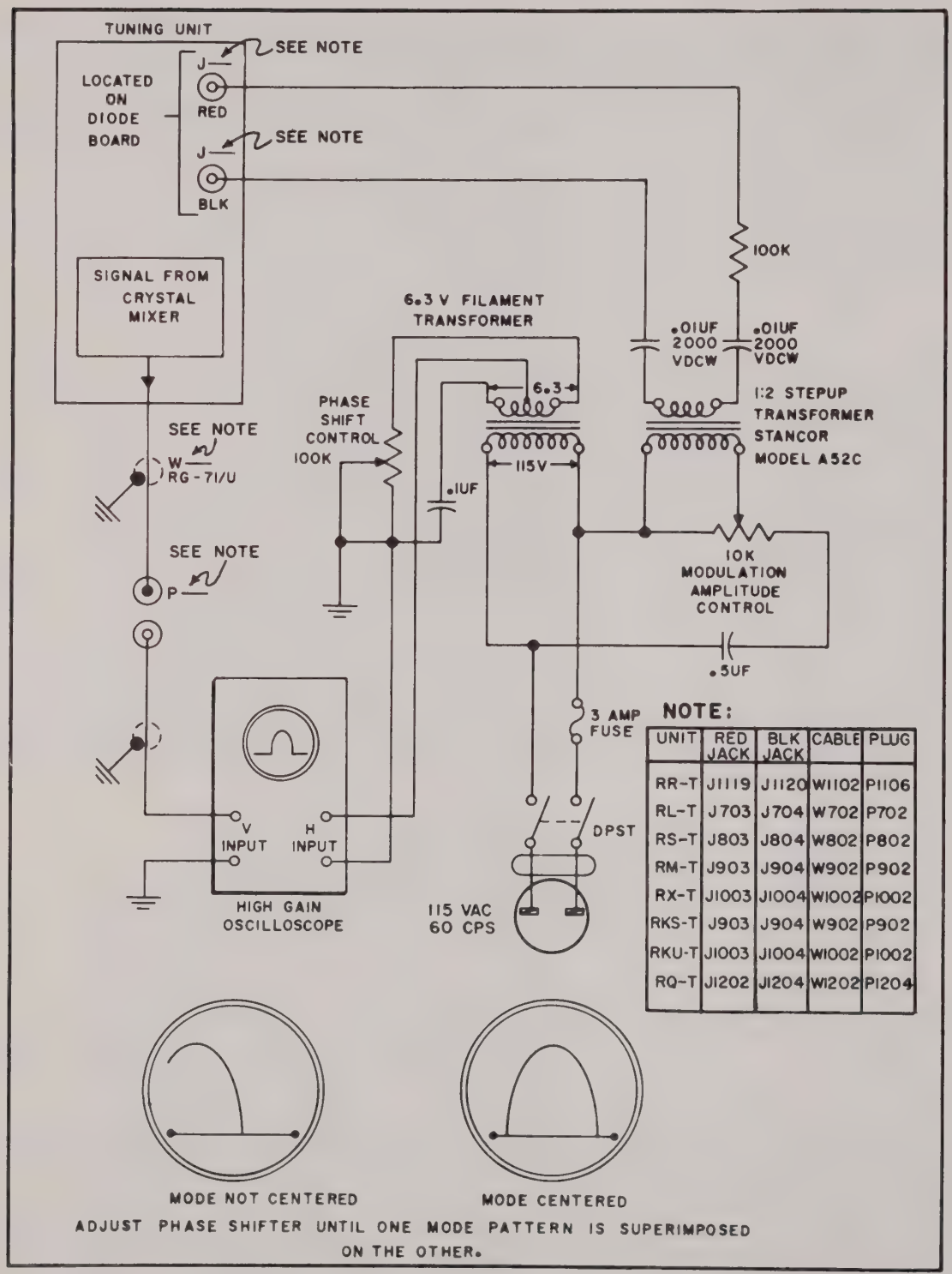


FIGURE 8-5. TEST SET-UP FOR TRACKING MODE PATTERNS

NOTE

All potentiometers located on the Tuning Unit are provided with shaft locks. Use a spin type hex wrench, of 7/16 inch spacing across flats, to loosen the locknut. After a shaft adjustment has been completed, retighten the locknut, without disturbing the desired position of the potentiometer control shaft. When tightening or loosening the locknut, use an open end wrench to prevent the body of the locking device from rotating on its shaft.

(2) The following adjustments apply to all Tuning Unit models except those employing Mode Switching (Models RX-T, RKU-T and RQ-T).

(a) Set the tuning dial to the frequency designated "Low" in Table 8-3 for the appropriate Tuning Unit Model. Now slowly turn the Modulation Amplitude control to its extreme counterclockwise setting. If the D.C. reflector voltage is correct, the 2-3/4 cycle mode trace will disappear symmetrically about the center, with the center portion disappearing last. If this is not the case, adjust the LOW ADJ control located on the potentiometer control panel (on the left side of the Tuning Unit), until the correct reflector voltage is obtained.

(b) Repeat the above procedure after setting the tuning dial to the frequency designated "High" in Table 9-3. After setting the Modulation Amplitude control to an appropriate setting, slowly rotate this control to its extreme counterclockwise position. If the reflector mode does not disappear symmetrically about the center, adjust the HIGH ADJ control until a symmetrical drop-out of the mode trace is obtained.

(c) The repeller voltage adjustment must again be checked at the low and high frequencies because of the interacting effects of the LOW ADJ and HIGH ADJ controls. Minor adjustments of these potentiometers may be made, as necessary, to complete the adjustment procedure.

TABLE 8-3
TRACKING ALIGNMENT FREQUENCIES

Tuning Unit Model	Low Frequency	High Frequency
RL-T	950 mc	2040 mc
RS-T	1890 mc	4320 mc
RM-T	4190 mc	7720 mc
RKS-T	9500 mc	15, 600 mc
RR-T	400 mc	1000 mc

(d) After completing the repeller tracking, remove the connections to the diode board test jacks and reconnect the cable to the preamplifier input jack.

(e) If critical adjustment of the AFC circuit operation is desired, the lead from pin N of the Tuning Unit connector to pin 3 of the HIGH ADJ control may be opened at the jumper provided on the terminal strip located above the potentiometer mounting board. The jumper terminals are labeled "+" and "-". Remove the jumper and insert a 0-10 milliammeter, such as the Simpson Model 373, in place of the jumper from "+" to "-". After tracking is completed, adjust the REFL 1 ADJ control to obtain a meter-pointer deflection of 7 milliamperes. Be sure to maintain the 600-volt meter pointer deflection for the reflector supply voltage as directed in step d (1)(a), above.

(f) Remove the milliammeter and replace the jumper, after completing the procedure outlined in step (e) above.

(3) The following procedures apply only to the Tuning Unit Models RX-T, RQ T and RKU-T.

(a) Set the Tuning Unit to a frequency slightly less than the one designated "Middle" in Table 8-4 for appropriate Tuning Unit. Now slowly turn the Modulation Amplitude control to its extreme counterclockwise setting. If the D.C. reflector voltage is correct, the 3-3/4 mode trace will disappear about the center, with the center portion disappearing last. If this is not the case adjust the TRACK 1 control, located on the potentiometer control panel (on the left side of the Tuning Unit), until the correct reflector voltage is obtained just below the middle frequency setting.

(b) Now change the dial setting to the frequency designated "Low" in Table 8-4. The centering is again performed with respect to the 3-3/4 reflector mode. If, after rotating the Modulation Amplitude control to its extreme counterclockwise position, the 3-3/4 reflector mode does not disappear symmetrically about its center, adjust the LOW ADJ control until a symmetrical drop-out of the mode trace is obtained.

(c) The Tuning Unit is now tuned to a frequency (designated Middle in Table 8-4) just above the mode switch point. This time the centering is performed with respect to the 4-3/4 cycle repeller mode. First return the Modulation Amplitude control to a position which produced a complete mode on the oscilloscope. Then slowly turn the Modulation Amplitude control to its extreme counterclockwise position. If the 4-3/4 reflector mode trace does not disappear symmetrically about the center, adjust the Track 2 control until a symmetrical drop-out of the mode trace is obtained.

(d) Repeat the above procedure at the tuning dial setting designated "High" in Table 8-4, for the respective Tuning Unit. After setting the Modulation Amplitude control to an appropriate setting, slowly rotate this control to its extreme counterclockwise setting. If the reflector mode does not disappear symmetrically, adjust the HIGH ADJ potentiometer until a symmetrical drop-out of the mode trace is obtained.

(e) The reflector voltage alignment must now be checked at both sides of the middle frequency as well as at the low and high frequencies, because of the interacting effects of tracking potentiometers TR1 and TR2, as well as the LOW and HIGH ADJ controls. Minor adjustments of these potentiometers may be made, as necessary, to complete the alignment procedure.

TABLE 8-4
TRACKING ALIGNMENT FREQUENCIES

Tuning Unit Model	Low Frequency	Middle Frequency	High Frequency
RKU-T	14,700 mc	19,060 mc	22,000 mc
RX-T	7,300 mc	9,660 mc	11,260 mc
RQ-T	20.3 kmc	25.76 kmc	46.7 kmc

(f) After completing the reflector tracking, remove the connections to the diode board test jacks and reconnect the cable to the preamplifier input jack.

(g) If critical adjustment of the AFC circuit operation is desired, the lead from pin N of the Tuning Unit connector to pin 3 of the HIGH ADJ control may be opened at the jumper provided on the terminal strip located above the potentiometer mounting board. The jumper terminals are labeled "+" and "-". Remove the jumper and insert a 0-10 milliammeter, such as the Simpson Model 373, in place of the jumper from "+" to "-". Be sure to maintain the 600-volt meter pointer deflection for the reflector supply voltage as directed in step d.(1)(a) above.

(h) Remove the milliammeter and replace the jumper after the procedure outlined in step (g) above.

4. RF OSCILLATOR CALIBRATION PROCEDURE.

a. SCOPE -- Due to variations in klystron characteristics, replacement of a klystron within a Tuning Unit will usually require recalibration of the RF oscillator.

b. DETERMINING NEED FOR OSCILLATOR CALIBRATION -- Perform a check of local oscillator frequency versus dial reading immediately after replacing the klystron tube. In the case of all Tuning Units not containing the mode selection feature (refer to Part II, Section V, Paragraph 4 e), this check is to be performed independently of the preselector bandpass curve, as this will also require readjustment. If the local oscillator frequency of these Tuning Units differs from the dial frequency by more than one percent, retracking of the oscillator cam is required. For Models RKS-T and RKU-T, the local oscillator frequency may be calibrated as follows:

For the Model RKU-T:

$$\text{L.O. FREQ.} = \frac{\text{Dial Freq. } -260}{2}$$

For the Model RKS-T:

$$\text{L.O. FREQ.} = \frac{\text{Dial Freq. } +260}{2}$$

For the lower dial frequencies of 20.3 kmc to 31.2 kmc of Model RQ-T:

$$\text{L.O. FREQ.} = \frac{\text{Dial Freq. } -260}{2}$$

For the upper dial frequencies of 30.3 kmc to 46.7 kmc of Model RQ-T:

$$\text{L.O. FREQ.} = \frac{\text{Dial Freq. } -260}{3}$$

If the results are greater than one percent, retracking of the oscillator cam is required.

c. OSCILLATOR FREQUENCY CHECK -- To check the oscillator frequency of all Tuning Unit Models proceed as follows:

(1) BE SURE TO TURN OPERATING POWER OFF. Throw the POWER switch to its OFF position, and remove the power input cable from the rear of the equipment.

(2) Loosen the four captive fasteners, located at the corners of the Tuning Unit front panel, which retain the unit in the equipment cabinet. Remove the Tuning Unit from the cabinet. Sufficient slack in the cabinet has been provided so that the Tuning Unit may be placed on a workbench in front of the basic instrument. Place the Tuning Unit in a position so that the oscillator cam adjustments are accessible, while observing indications on the panel-mounted meter.

(3) Use a signal generator with a known frequency accuracy of one percent or better, having an R. F. output which covers the frequency ranges of the units listed in Table 8-5. Couple the output of the signal generator directly to the R. F. INPUT connector on the Tuning Unit.

TABLE 8-5

R. F. SIGNAL GENERATOR CALIBRATION FREQUENCIES

Tuning Unit Model	Signal Generator Frequency Range
RR-T	395 mc to 1005 mc
RL-T	950 mc to 2040 mc
RS-T	1900 mc to 4320 mc
RM-T	4200 mc to 7740 mc
RX-T	7300 mc to 11260 mc
RKS-T	9500 mc to 15600 mc
RKU-T	14700 mc to 22000 mc
RQ-T	20300 mc to 46700 mc

(4) Set the front panel control for normal operation for receiving a c-w signal as described in Part I, Section III, Paragraph 9.

(5) Connect the power input cable and place the POWER switch to its ON position. Allow sufficient time for both the receiver and signal generator to stabilize.

d. INITIAL ADJUSTMENT

(1) Turn the Tuning Dial of the receiver until the oscillator cam follower is at the fixed section of the tuning cam, adjacent to the two small holes which terminate the arcs of the cam. (See figure 8-6.) The receiver tuning dial will be approximately set to the frequency listed below for the particular tuning unit:

Model RR-T	670 mc
Model RL-T	1550 mc
Model RS-T	3225 mc
Model RM-T	6180 mc
Model RX-T	9500 mc
Model RKS-T	12,200 mc
Model RKU-T	19,100 mc
Model RQ-T	26.26 kmc

(2) Set the frequency control of the signal generator so that an output signal approximately equal to the Tuning Dial frequency is produced. Then carefully tune the signal generator frequency control until a deflection to the right is obtained on the panel-mounted meter. Note the frequency setting of the signal generator at this point.

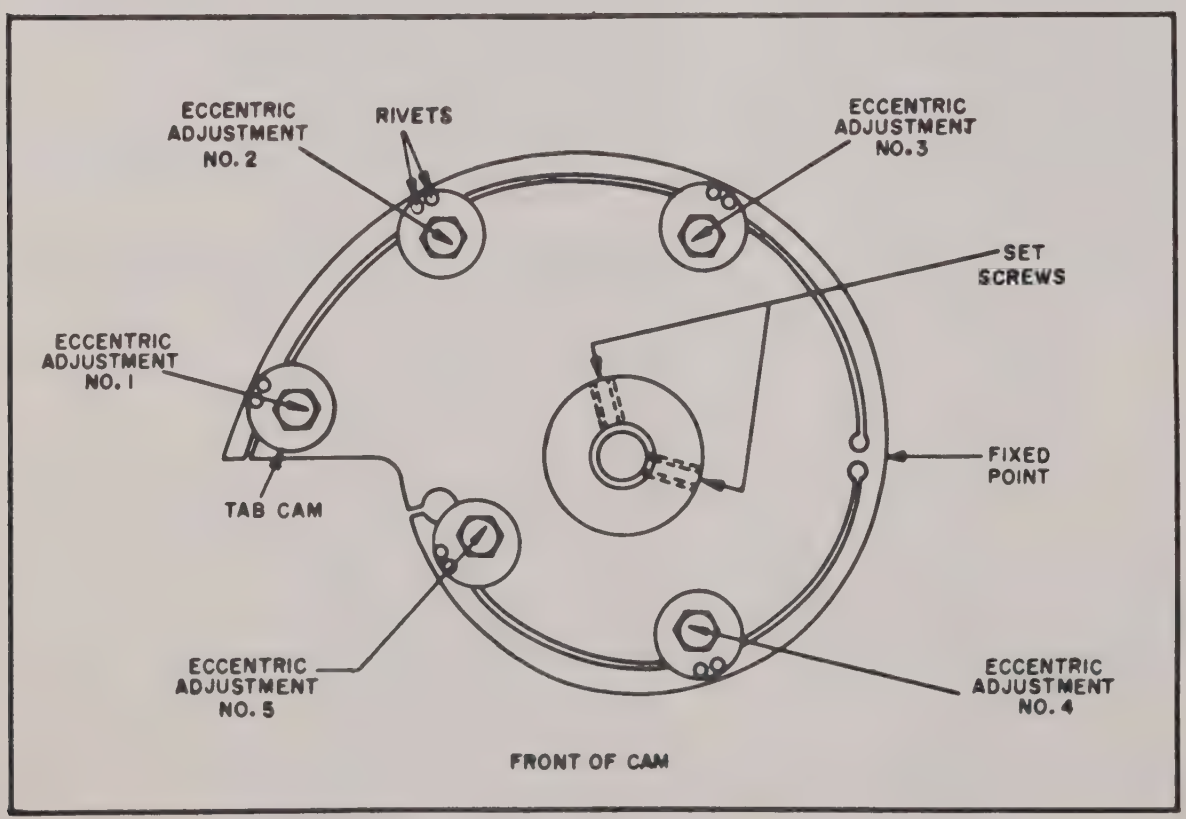


FIGURE 8-6. OSCILLATOR ADJUSTABLE TUNING CAM

(3) Rotate the signal generator frequency control 520 mc above and below the setting of step 2, immediately above, until a second deflection is obtained on the meter, and note this frequency setting. The lower frequency setting is the desired output signal. The higher frequency setting is the image frequency (except for Model RX-T which is 520 mc below).

(4) Reset the signal generator control to its lower setting. If the frequency reading on the signal generator is within ± 1% of the receiver tuning dial reading, no frequency correction is required. If a frequency correction is required, proceed as directed in step 5 below.

(5) To obtain a frequency correction, adjust the set screw located on the oscillator drive yoke, while tracking with the signal generator frequency control. Obtain a condition of maximum pointer deflection on the front panel meter when the signal generator dial reading corresponds precisely to the receiver dial reading.

(6) To check that the best possible mode centering is still present after changing the position of the choke within the klystron oscillator cavity, repeat the oscillator tracking procedures.

e. TUNING CAM ADJUSTMENT

(1) After completing the initial adjustment described in c., above for any one of the units specified, check the accuracy of the Tuning Unit dial reading against the frequency of the signal generator, employing the procedure described above. If the accuracy of the receiver dial falls outside the ± 1% tolerance limits at any point over the tuning range, fine adjustment is made by means of the adjustable tuning cam. (See figure 4-6) Five eccentric hex bolts and five locknuts on the cam are to be adjusted as directed below.

(2) Slightly loosen (approximately 1/2 turn counterclockwise each of the five nuts on the rear of the tuning cam. These nuts are accessible from the top of the Tuning Unit.

CAUTION

Do not remove the nuts completely, since they may fall into the other components on the chassis.

(3) Rotate the frequency dial until the cam follower is adjacent to one of the adjustment points, consisting of the eccentric bolt and nut, on the tuning cam.

(4) Turn the eccentric adjustable bolt until the frequency of the signal generator is within ± 1% of the dial reading on the receiver.

(5) Now rotate the frequency dial until the cam follower is adjacent to the next adjustment point on the cam and repeat the procedure outlined in step 4, above.

(6) Follow the same procedure for each of the remaining three adjustment points on the tuning cam.

(7) After making each adjustment, tighten each tuning cam nut, using two open-end wrenches throughout the procedure. Both the hex-head nuts and bolts are 5/16 inch wide across the flats.

CAUTION

Hold the hex-head bolt firmly in the desired position with one open-end wrench, while tightening the corresponding nut, so that the proper bolt setting is not varied. Start from center frequency (paragraph d, step 1) and work towards extreme ends of shearing of rivets may result.

(8) At the extreme limits (points 1 and 5, figure 4-6), the adjustment bolt and nut may not fall opposite the cam follower, due to the limits of cam shaft rotation. In this event, adjust the bolt and nut when the adjustment point is as close as possible to the cam follower.

5. PRESELECTOR ADJUSTMENTS.

a. INTRODUCTION - - The preselector adjustments are made only on Tuning Unit Models RL-T, RS-T, RM-T RX-T and RR-T.

b. TAPE CAM ADJUSTMENT - - After replacement of a klystron local oscillator it will usually be necessary to retune the preselector (where one is used) to insure that the Tuning Unit will operate with optimum sensitivity. In addition, periodic rechecking of preselector tuning will permit operation at peak performance. To perform this realignment for the above units, proceed as follows:

(1) BE SURE TO TURN OPERATING POWER OFF. Throw the POWER switch to its OFF position and remove the power input cable from the rear of the equipment.

(2) Loosen the four captive fasteners, located at the corners of the Tuning Unit front panel, which retain the unit in the equipment cabinet. The Tuning Unit may be withdrawn from the front of the cabinet. Sufficient slack in the cabling has been provided so that the Tuning Unit may be placed on the bench in front of the equipment in such a position that the adjustment screws for the tape cam are accessible while observing the front panel meter.

(3) Connect the output from a signal generator operating in the frequency range listed in Table 8-5 for the particular Tuning Unit to be aligned. (Note: Table 8-6 for Tuning Unit Model RR-T) The output is fed into the front panel jack designated R.F. INPUT.

(4) Set the front panel controls for receiving a c-w signal as described in Part I, Section III, Paragraph 9.

(5) Connect the power input cable and place the POWER switch to its ON position. Allow ten minutes for equipment warm-up.

(6) Set the particular receiver frequency dial in the vicinity of the following frequency:

for Model RR-T - 400 mc
for Model RL-T - 950 mc
for Model RS-T - 1900 mc
for Model RM-T - 4200 mc
for Model RX-T - 7300 mc

(7) Adjust the main tuning knob until the tape cam follower is directly opposite the first adjustment screw. Note the dial reading.

(8) Tune the signal generator to the same frequency, and critically adjust the generator to obtain a maximum pointer deflection to the right, on the panel-mounted meter.

(9) Adjust the two screws (one for each tape cam) for a further increase in meter reading. Decrease the signal generator input to maintain an on-scale meter pointer deflection.

NOTE

If it is found that in step (9) above, or at any other point on the tape cam, insufficient range of adjustment is available in both adjustment screws, it may be necessary to perform the coarse adjustment described in subparagraph c, below, before proceeding with the remaining adjustments.

(10) Repeat the above procedure for the remaining screws on the two tape cams. Set the receiver so that the cam follower is opposite an adjustment screw. Tune the signal generator for a maximum meter pointer deflection.

(11) Repeat the entire procedure to recheck the alignment, since there is some interaction between adjacent screw adjustments.

c. COARSE ADJUSTMENT - - Fine adjustment of the preselector plungers has been provided by means of the tape cam. If insufficient adjustment, by means of the screws on the tape cam, is available, it will be necessary to make an initial coarse adjustment. To perform this operation, proceed as described below:

(1) Repeat steps (1) through (8) in paragraph b., above.

(2) Set the adjustment screws on the tape cams to their mean or middle position.

(3) Adjust the two screws located on the correcting mechanism for an increase in meter reading. Decrease the signal generator input to maintain an on-scale meter pointer-deflection.

(4) Proceed to the tape cam adjustment, as directed in steps (10) and (11), immediately above.

6. CRYSTAL MIXER.

a. REPLACEMENT OF CRYSTAL DIODE - - The crystal diodes used as the first crystal mixers are listed in Table 8-7. The diode is seated within the crystal mixer. If replacement of the crystal diode becomes necessary, proceed as directed below:

TABLE 8-7
TUNING UNITS AND ASSOCIATED CRYSTAL DIODES

Tuning Unit Model	Reference Number	Type of Diode
RR-T	CR1006	1N21D
RL-T	CR701	1N23C
RS-T	CR801	1N23C
RM-T	CR901	1N23C
RX-T	CR1001	1N78
RKS-T	CR901	1N286
RKU-T	CR1001	1N286
RQ-T	CR1201 CR1202	1N26 1N53

(1) BE SURE TO TURN OPERATING POWER OFF. Throw the POWER switch to its OFF position, and remove the power input cable from the rear of the equipment.

(2) Loosen the four captive fasteners, located at the corners of the Tuning Unit front panel, which retain the unit in the equipment cabinet. The Tuning Unit may be completely withdrawn from the front of the cabinet. The crystal mixer is now accessible for replacement of the crystal diode.

(3) Unscrew the knurled nut located at the end of cable W702, and remove the connector. The crystal diode is now accessible for replacement.

(4) Replace the defective crystal diode with one known to be in a satisfactory operating condition.

7. PREAMPLIFIER FILTER

a. EQUIPMENT REQUIRED. A signal generator with a calibrated output at a frequency of 260 mc for model RQ-T, RKS-T, RKU-T and RR-T is required to align the preamplifier filters used with the Tuning Units. In addition, the basic unit local oscillator circuit should br properly aligned as directed in Part I, Section IV, Paragraph 5.

b. PROCEDURE. To align the preamplifier filter, proceed as directed below:

(1) Set the METER SELECTOR to its USE position.
(2) Set the FUNCTION SELECTOR to its AVERAGE position.
(3) Set the CALIBRATE-MANUAL switch to its CALIBRATE position.
(4) Set the METER SCALE selector to its LIN. position.
(5) Set the CALIBRATE GAIN control to obtain a pointer deflection of 2 on linear red scale on the panel mounted meter.
(6) Apply a signal at approximately 260 mc directly into the preamplifier filter.
(7) Adjust the signal generator to obtain a half-scale pointer deflection on the panel-mounted meter.
(8) Tune inductors L1113 and L1114 for a pointer deflection further to the right on the panel-mounted meter.
(9) Attenuate signal until pointer is at 2.8 on red linear scale. If preamplifier is working properly, a sensitivity of approximately 3 microvolts should register on generator attenuator.

c. Check that the preamplifier filter is now functioning properly. A signal generator with a calibrated output covering the frequency range from 255 mc to 265 mc is required. In addition a detector which is designed for operation at 260 mc, and which has a 50 ohm input impedance, is required. To perform this check, proceed as follows:

(1) Disconnect cable W1201 on Model RQ-T (W1102 on Model RR-T) from input jack J1106 (on the preamplifier filter chassis). Also disconnect cable W102 from 140 mc output jack J203 (J1111) (on the preamplifier chassis).

(2) Connect the detector to J203. (J1111)
(3) Apply a 260 mc signal, at a level of 50 millivolts, to input jack J1106 (on the preamplifier filter chassis).
(4) Adjust the signal generator frequency for maximum output.
(5) Tune inductor L204 (L1120) for maximum output. Observe the indicated output.

NOTE

If the inductor does not peak, it may be necessary to vary the length of the cable which connects the output of the signal generator to input jack J1106.

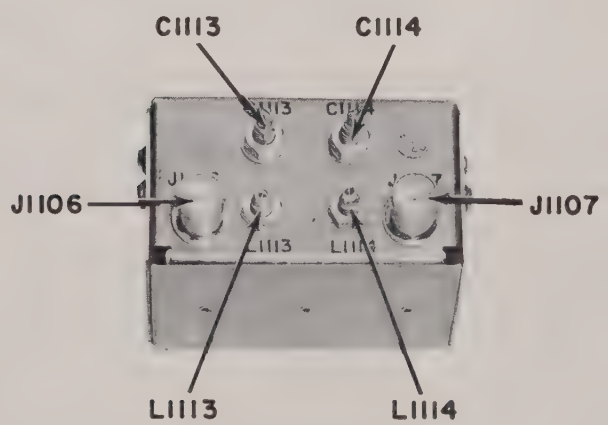


FIGURE 8-7. PREAMPLIFIER FILTER CHASSIS, TOP VIEW

(6) The following values indicate proper functioning of the equipment:

Voltage Gain.....2 to 5
Bandwidth.....7 mc

(7) Disconnect cable 1202, Model RQ-T (Cable W1103, Model RR-T) from input jack J206, Model RQ-T (J1109, Model RR-T). Connect a signal generator to J206 (J1109). Adjust input to give the same indicated output as in step (5). The differences in signal generator outputs in steps (5) and (6) should be no more than 3 db.

8. PREAMPLIFIER.

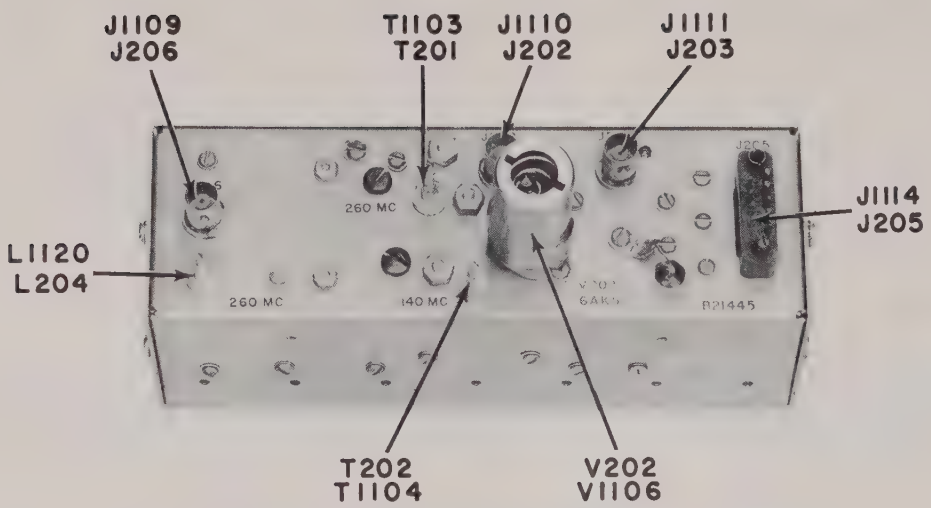
a. EQUIPMENT REQUIRED. Each Tuning Unit requires the use of a signal generator with a calibrated output at the frequency given in Table 8-8. It is assumed that the klystron local oscillator is functioning properly. In addition, the local oscillator circuit should be properly aligned as directed in Part I, Section IV, Paragraph 5.

TABLE 8-8
PREAMPLIFIER ALIGNMENT, SIGNAL GENERATOR FREQUENCIES

Tuning Unit Model	Signal Generator Frequency
RL-T	1500 mc
RS-T	3100 mc
RM-T	6000 mc
RX-T	9000 mc
RKS-T	11,000 mc
RKU-T	17,740 mc
RR-T	670 mc
RQ-T	26,400 mc

b. PROCEDURE. To align the preamplifier, proceed as directed below:

(1) Set the METER SELECTOR to its USE position.
(2) Set the FUNCTION SELECTOR to its AVERAGE position.
(3) Set the CALIBRATE-MANUAL switch to its CALIBRATE position.
(4) Set the METER SCALE selector to its LIN. position.
(5) Set the CALIBRATE GAIN control to obtain a pointer deflection of 2 on red linear scale on the panel-mounted meter.
(6) Apply a signal at the frequency given in Table 8-8 for the proper Tuning Unit to the front panel R. F. INPUT jack.
(7) Tune the receiver for maximum pointer deflection on the panel-mounted meter.
(8) Adjust the signal generator input to obtain a half-scale pointer deflection on the meter.
(9) Tune I. F. transformers T202, T201, and inductor L204, for a pointer deflection further to the right on the panel-mounted meter.



1000 SERIES DESIGNATION ON MODEL RR-T R-F TUNING UNIT.

FIGURE 8-8. PREAMPLIFIER CHASSIS, TOP VIEW

c. To check that the preamplifier is now functioning properly, proceed as follows:

(1) Remove the input signal from the R.F. INPUT jack.

(2) Set the METER SCALE selector to its LIN position.

(3) Set the CALIBRATE-MANUAL switch to its MANUAL position.

(4) Set the MANUAL GAIN control for maximum gain.

(5) The meter will now indicate the noise level of the receiver. Check that the meter pointer deflects between the 3 and 5 calibration marks, on the linear scale.

d. A further check on preamplifier performance may now be made. A signal generator, with a calibrated output covering the frequency range from 255 to 265 mc, is required. In addition, a detector, which is designed for operation at 260 mc, and which has a 50-ohm input impedance, is required. To perform this check, proceed as follows:

(1) Disconnect cable from input jack J206 (J1106, Tuning Unit Model RR-T, only) on the preamplifier chassis. Also disconnect cable W102 from output jack J203, (J1111, Tuning Unit Model RR-T, only).

(2) Connect the detector to output jack J203 (J1111, Model RR-T).

(3) Apply a 260 mc signal, at a level of 50 millivolts, to input jack J206 (J1106, Model RR-T).

(4) Adjust the signal generator for maximum output.

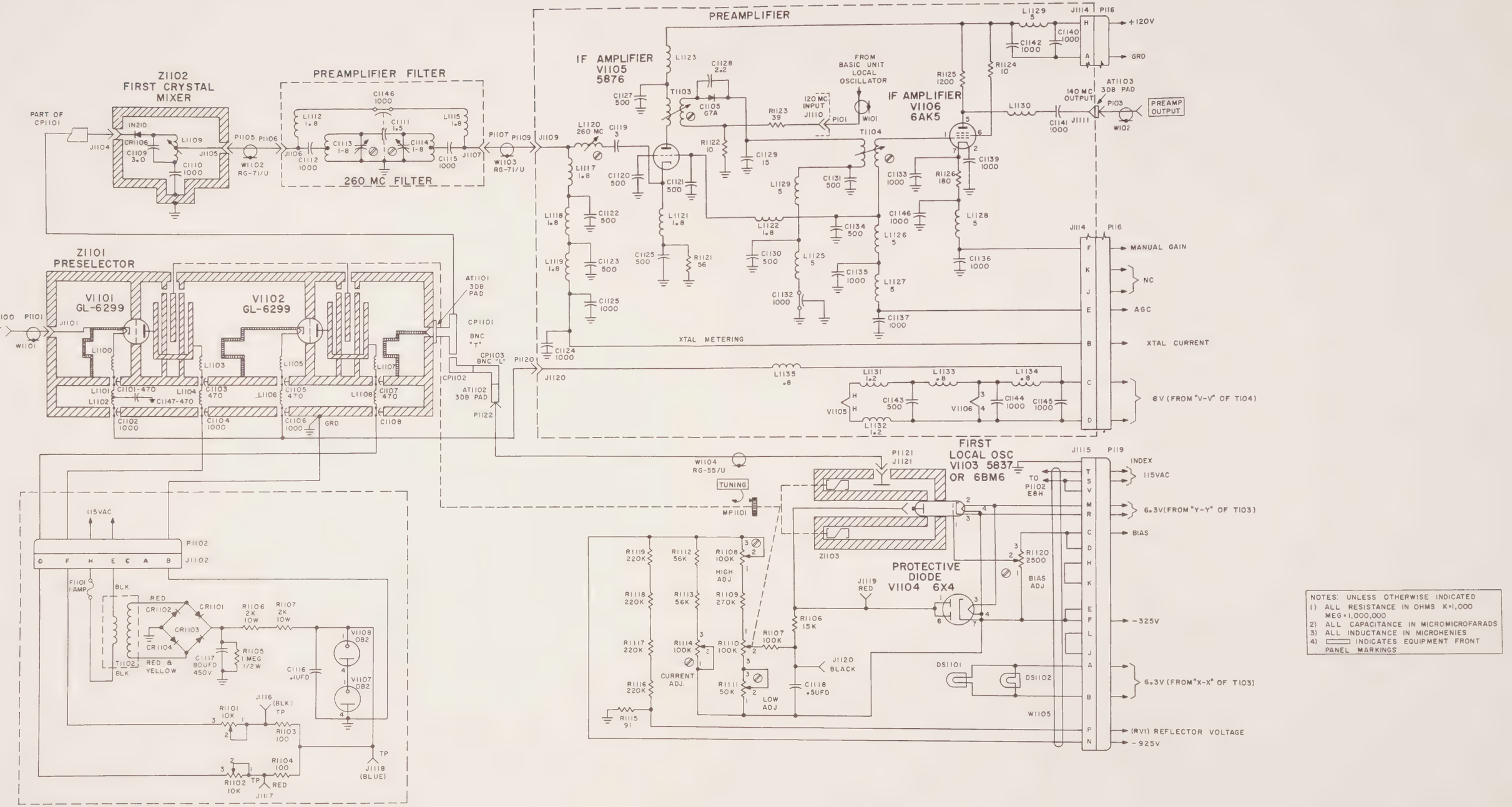
(5) Tune inductor L204 (L1120, Model RR-T only) for maximum output.

NOTE

If the inductor does not peak, it may be necessary to vary the length of the cable which connects the output of the signal generator to input jack.

(6) The following values indicate proper functioning of the equipment.

Voltage Gain.....3 to 5
Bandwidth.....7 mc



NOTES: UNLESS OTHERWISE INDICATED
1) ALL RESISTANCE IN OHMS K=1,000 MEG=1,000,000
2) ALL CAPACITANCE IN MICROMICROFARADS
3) ALL INDUCTANCE IN MICROHENIES
4) ▭ INDICATES EQUIPMENT FRONT PANEL MARKINGS

FIGURE 8-9. MODEL RR-T TUNING UNIT, SCHEMATIC DIAGRAM

BP22522-8 (SERIAL NO. 171 AND UP)

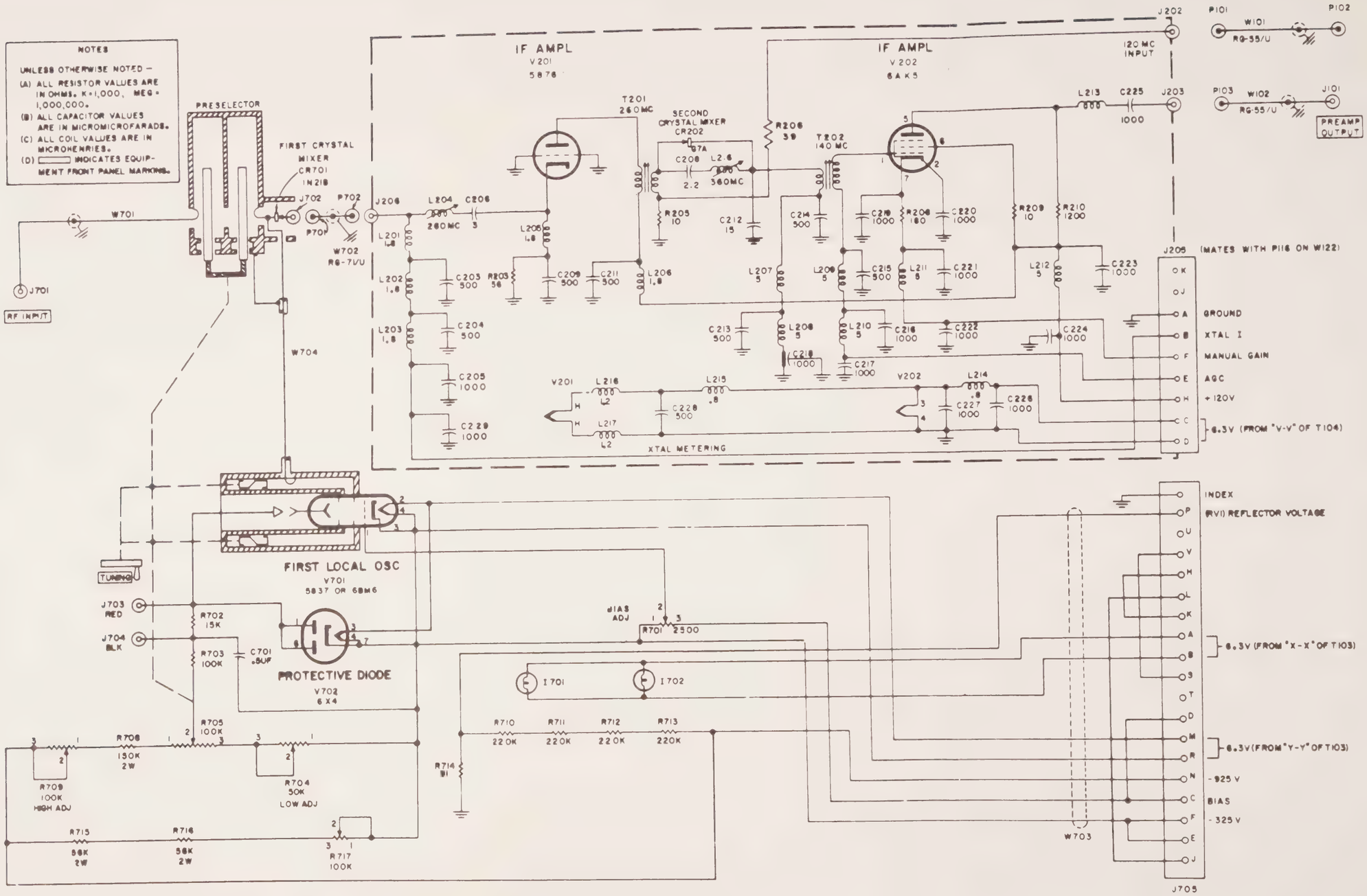


FIGURE 8-10. MODEL RL-T TUNING UNIT, SCHEMATIC DIAGRAM

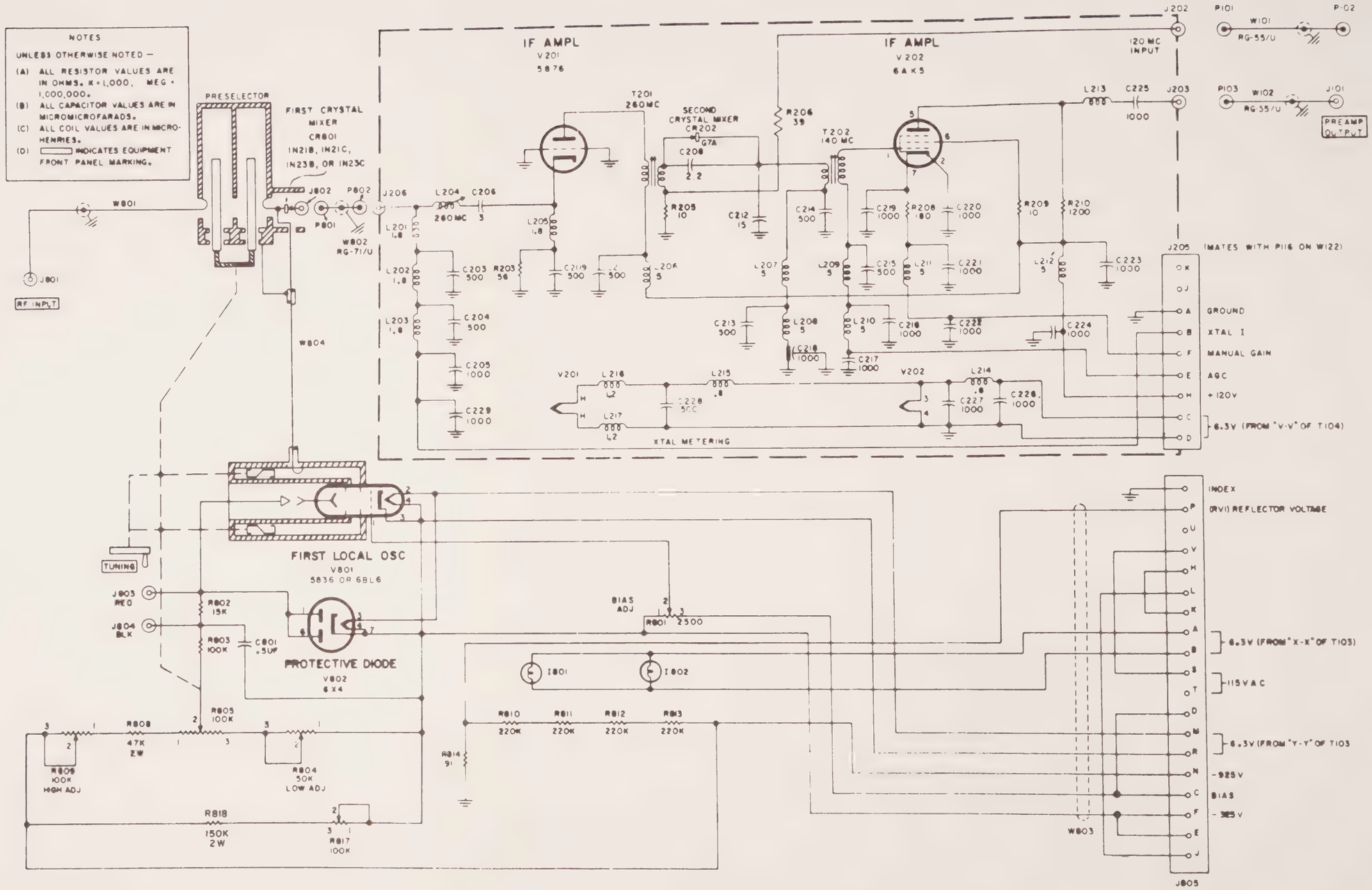


FIGURE 8-11. MODEL RS-T TUNING UNIT, SCHEMATIC DIAGRAM

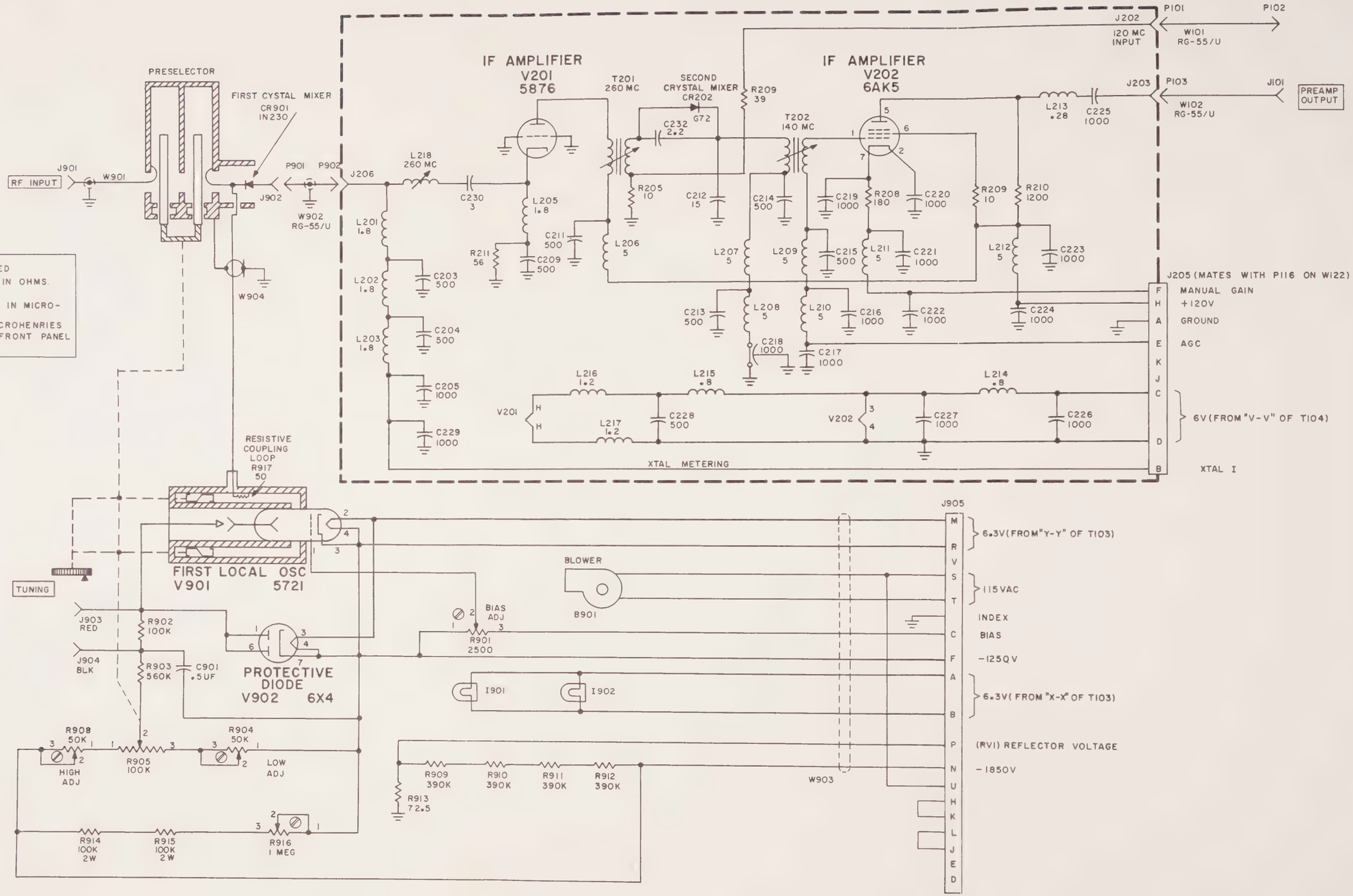


FIGURE 8-12. MODEL RM-T TUNING UNIT, SCHEMATIC DIAGRAM

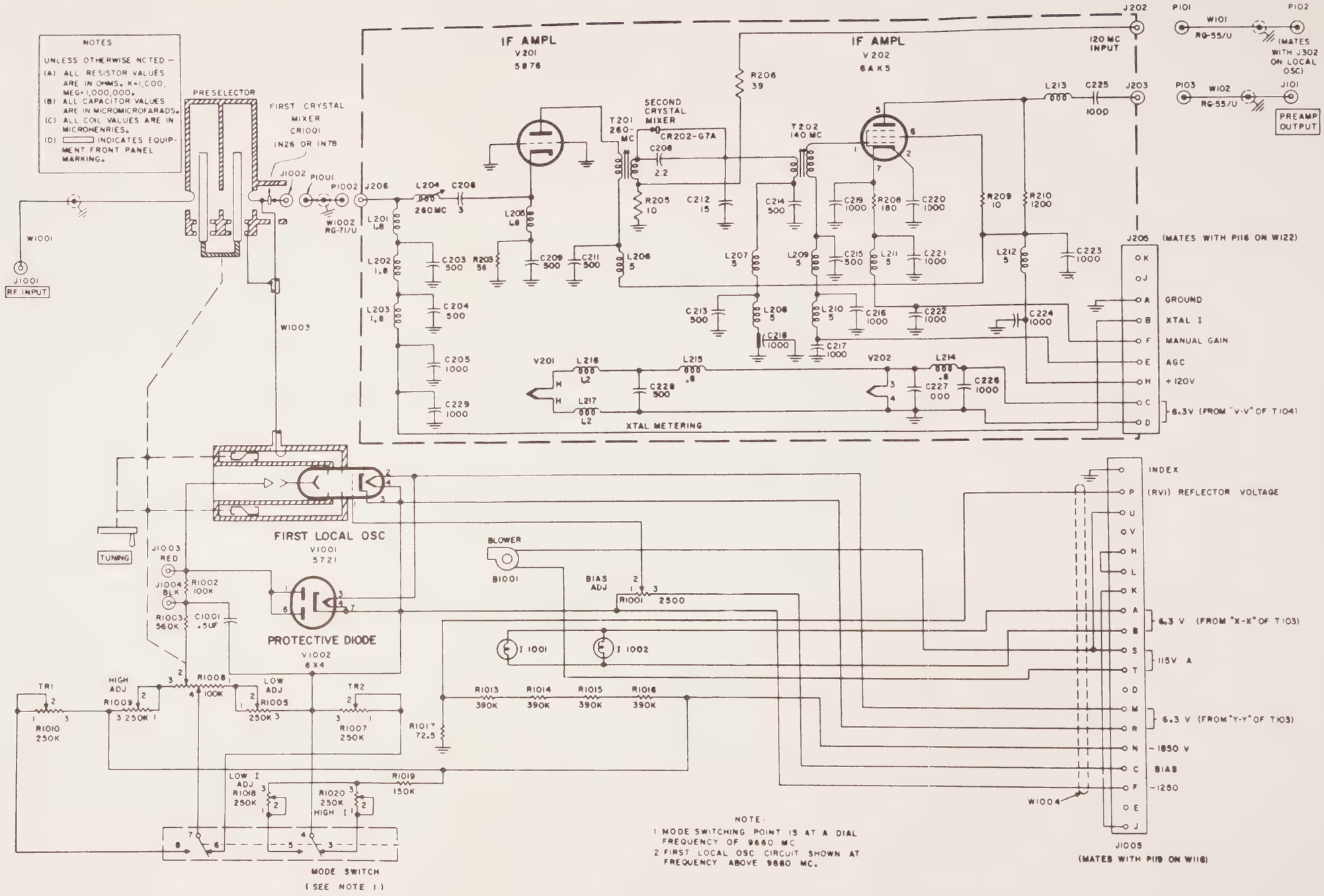
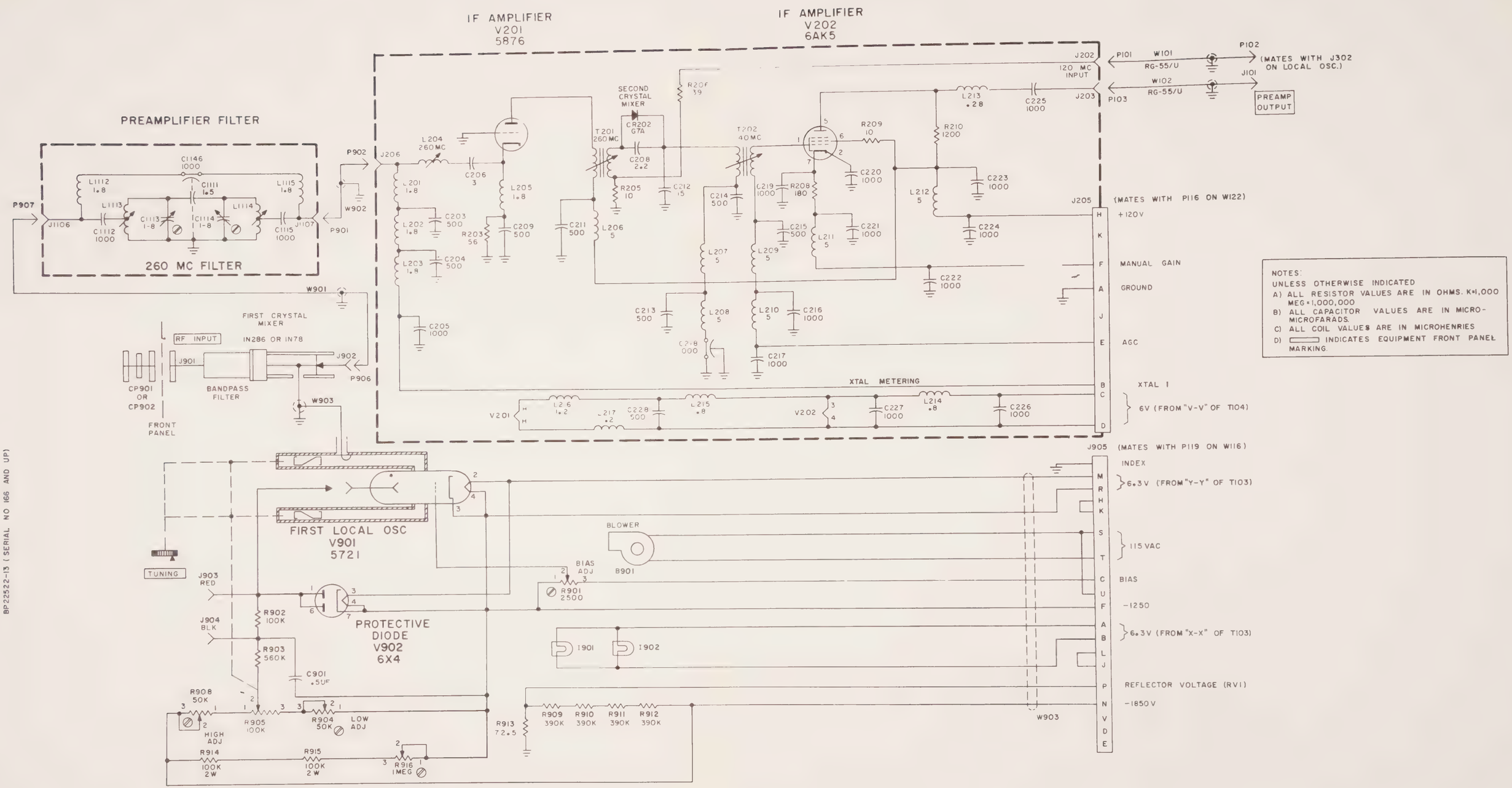


FIGURE 8-13. MODEL RX-T TUNING UNIT, SCHEMATIC DIAGRAM



NOTES:
UNLESS OTHERWISE INDICATED
A) ALL RESISTOR VALUES ARE IN OHMS. K=1,000 MEG=1,000,000
B) ALL CAPACITOR VALUES ARE IN MICRO-MICROFARADS.
C) ALL COIL VALUES ARE IN MICROHENRIES
D) ▭ INDICATES EQUIPMENT FRONT PANEL MARKING.

FIGURE 8-14. MODEL RKS-T TUNING UNIT, SCHEMATIC DIAGRAM

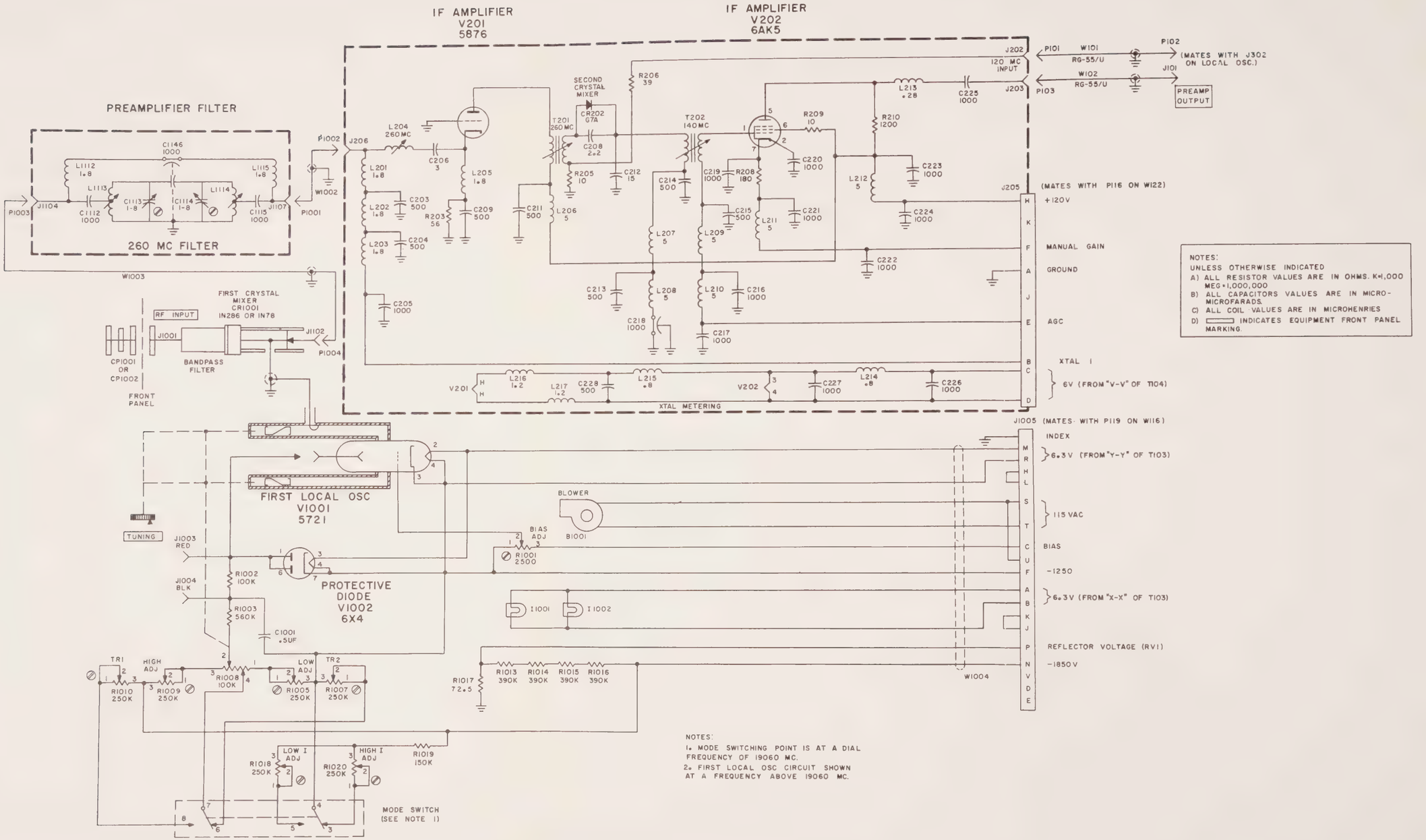


FIGURE 8-15. MODEL RKU-T TUNING UNIT, SCHEMATIC DIAGRAM

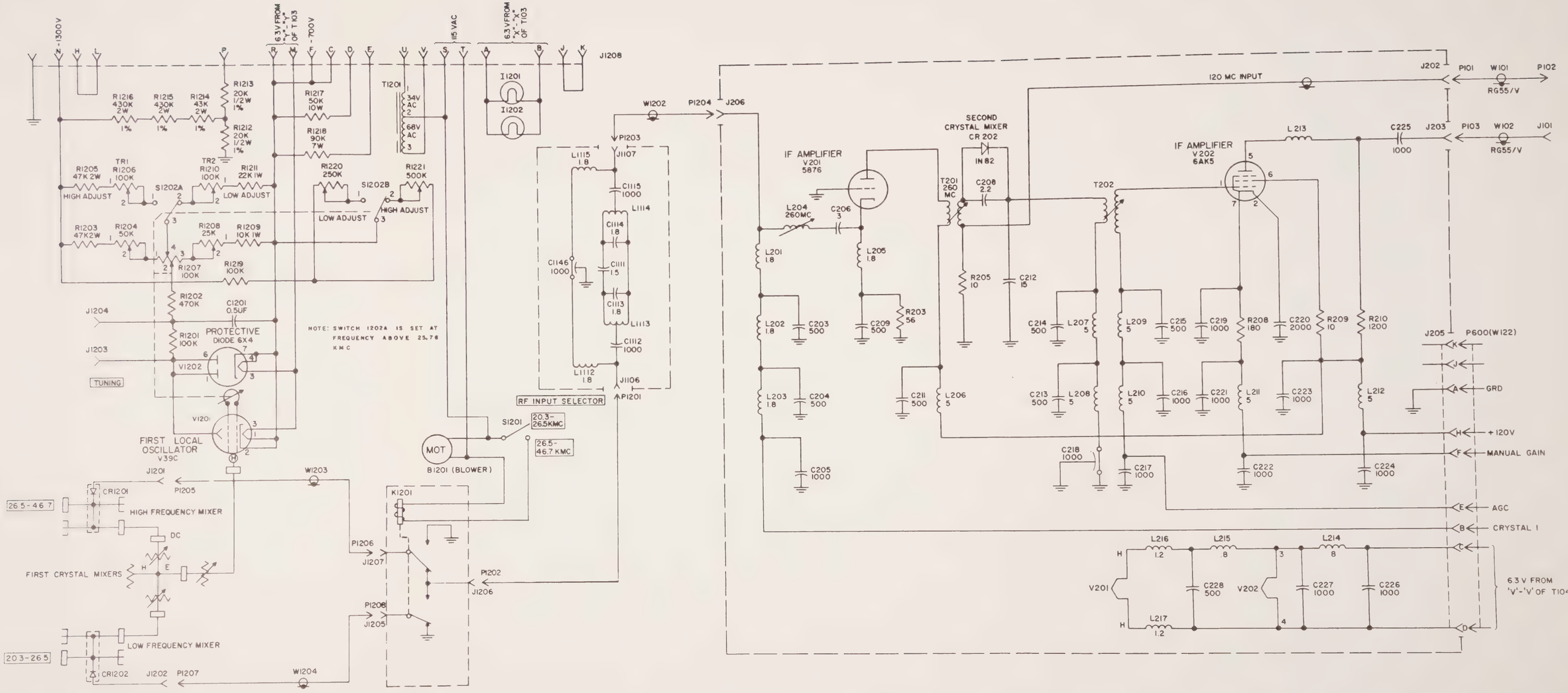


FIGURE 8-16. MODEL RQ-T TUNING UNIT, SCHEMATIC DIAGRAM

ADDENDUM I

MODEL R RECEIVER WITH RB-1 BASIC UNIT

Basic Unit Model RB-1 used in this Microwave Receiver is the same as Basic Unit Model RB described in this handbook with the following exceptions:

(a) To allow for forward or reverse rectification in the external crystal mixer (using Model RW-T Tuning Head) a XTAL CURRENT POLARITY switch (S115) has been added to the Meter M101 circuitry. (See figure A-1.) Switch S115 is located underneath the upper chassis of the basic unit on the front, left side.

(b) To permit use of an external Bolometer for obtaining square law measurements, a 40 mc output BOLOMETER connector (J115) has been added to the upper right hand portion of the front panel. The voltage output of L447, which was used for the AFC-FM SUB-ASSEMBLY J501 is now used in the Model RB-1 unit for this 40 mc output (See figure A-2.) The signal for the AFC-FM SUB-ASSEMBLY is taken off a tap located on L451 through C495 in the I-F Amplifier.

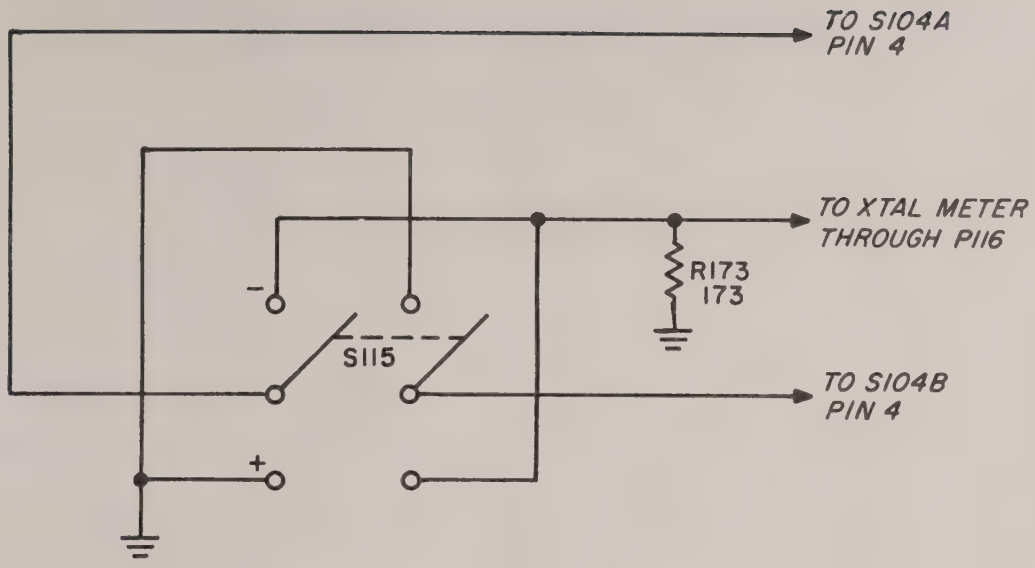


Figure A-1. Xtal Current Polarity S115, Simplified Schematic

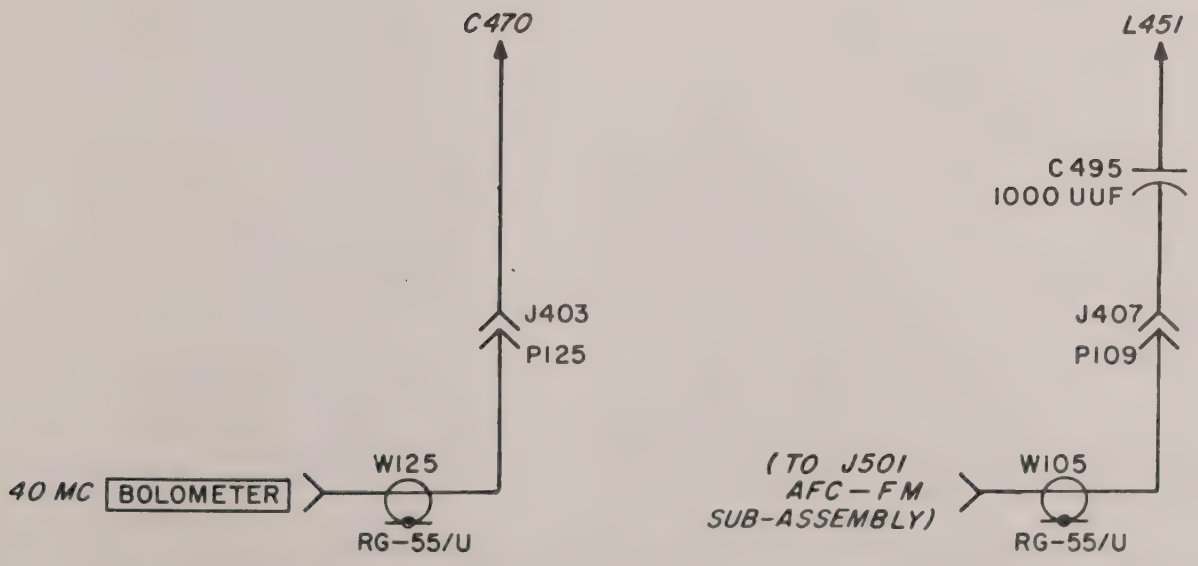


Figure A-2. Added 40-Mc Outputs (From I-F Amplifier)

POLARAD ELECTRONICS CORP.

CONSULTANTS — DESIGNERS — MANUFACTURERS

43-20 34th Street Long Island City 1, N. Y.

EXeter 2-4500

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL _____

_____ POSITION _____

SECTION OR DIVISION _____ PHONE NO. _____ EXT. _____

_____

EQUIPMENT _____ DATE OF PURCHASE _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

_____

TROUBLE REPORT:

A. Description of trouble _____

_____

_____

_____

_____

_____

B. Has trouble been localized? _____ If so, how and where: _____

_____

_____

_____

_____

_____

C. Instruments used and measurements taken, if any: _____

_____

_____

_____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date trouble occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

_____

H. Additional Comments: _____

_____

_____

_____

_____

_____

_____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, New York
ATTENTION: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will so notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

POLARAD — PROVEN RELIABILITY

POLARAD GUIDE TO MICROWAVE EQUIPMENT

MICROWAVE SPECTRUM ANALYZERS 10 to 100,000 mc

FEATURING:

- 1 to 30 cps adjustable sweep rate
- Direct-reading UNIDIAL® tuning control, with no klystron modes to set
- High accuracy, resolution and sensitivity
- Frequency dial accuracy ±1%
- Non-contacting klystron cavity chokes for noiseless tuning
- Five-inch flat-face CRT
- Provision for use with Multi-pulse Spectrum Decoder (Model SD-1)

TRANSISTORIZED MULTI-BAND, SINGLE UNIT SPECTRUM ANALYZER

Complete Frequency Coverage, From 10 to 40,880 mc

Model SA-84T

Completely transistorized lightweight unit.

Dispersion: 500 kc to 25 mc, adjustable

Resolution: 20 kc at all frequencies

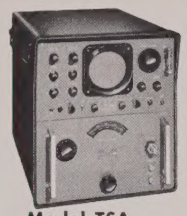
Internal Marker: ± 13 mc

Power Input: 115/230 VAC, 50/60 cps or 12 VDC

Power consumption: when battery operated, 110 watts

Sensitivity: —50 to —105 dbm, depending on frequency.

Weight: 70 lbs. One half the weight of conventional vacuum-tube equivalent



Model TSA

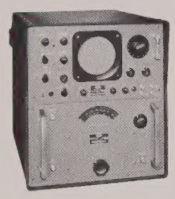
DIRECT READING SPECTRUM ANALYZER

10 to 44,000 mc in 5 Plug-In Tuning Units

To test missiles, radar, microwave components, telemetering and multi-pulse transmission

Features:

- **Dispersion:** 400 kc to 25 mc
- **Resolution:** 2 to 80 kc variable
- **Attenuation:** Continually variable
- **Sensitivity:** —50 to —95 dbm, depending on frequency
- Internal Marker: ± 14 mc



Model TSA-S

COMBINATION SYNCHROSCOPE-SPECTRUM ANALYZER

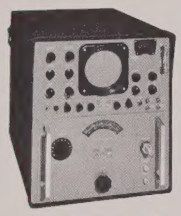
10 to 44,000 mc in 5 Plug-In Tuning Units

PROVIDES TIME AND FREQUENCY DISPLAYS

Time Display: Shows signal waveform

Frequency Display: Shows power vs. frequency

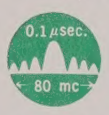
Bandwidth: 5 kc, 50 kc, 500 kc, 5 mc. Synchroscope sweep rate: 2, 10, 100, 1,000, 10,000 and 100,000 μ sec per screen diameter. Dispersion, Sensitivity and Internal Marker same as TSA.



Model TSA-W

WIDE DISPERSION SPECTRUM ANALYZER

FOR NARROW AND WIDE PULSE ANALYSIS
10 to 44,000 mc in 5 Plug-In Tuning Units



Dispersion: 200 kc to 80 mc (2 ranges)

Resolution: 2 to 80 kc variable

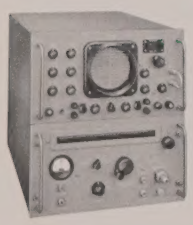
Internal Marker: ±40 mc

Screen Display: Linear or log

80 mc dispersion displays pulses narrow as 0.1 μ sec. For wide pulses, dispersion may be adjusted down to 200 kc.

UNIVERSAL SPECTRUM ANALYZERS

Complete frequency coverage 10-40,880 mc in single self-contained units—no additional tuning units required. Expanded, direct-reading, slide rule dial

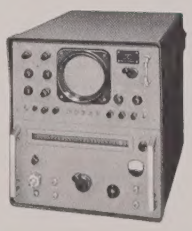


Model SA-84

- **Dispersion:** 10 to 55 mc: 500 kc to 5 mc, adjustable 55 to 40,880 mc: 500 kc to 25 mc, adjustable
- **Resolution:** 20 kc
- **Internal Marker:** variable

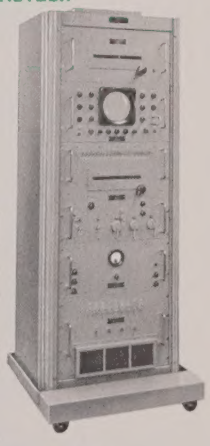
Model SA-84W
Wide Dispersion

- **Dispersion:** 10 mc to 240 mc: 10 mc 240 mc to 40,800 mc: 80 mc
- **Resolution:** 2 kc to 80 kc variable
- **Crystal controlled markers from 10 to 40,880 mc**
- **Log-linear display**
- **Accurately calibrated IF attenuator**



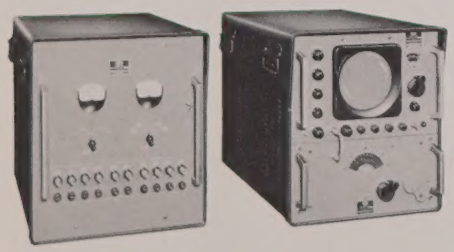
WIDE BAND SPECTRUM ANALYZER

Self-Contained Unit Covers 10 to 40,000 mc in 20 Bands



Model WSA

- **Dispersion:** 1 mc to 25 mc in narrow band 50 mc to 4000 mc in wide band
- **Resolution:** 20 kc in narrow band 1.5 mc in wide band
- Rapid band selection by means of illuminated push-button switches.
- Frequency marker up to 4000 mc.
- End-markers indicate frequency limits of each band.
- Center-marker permits switching from wide to narrow bands without hunting for r-f signal.
- **Sensitivity:** —50 to —80 dbm, depending on frequency.



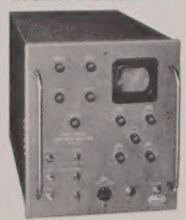
Model DA-70

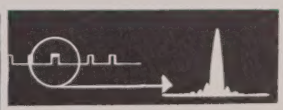
100 KMC SPECTRUM ANALYZER

Covers 50,000 mc to 100,000 mc in Three Bands

- **Dispersion:** Continuously adjustable from 50 mc to 1000 mc. Permits narrow pulse inspection.
- **Resolution:** 1 mc
- High intermediate frequency assures image rejection and prevents video detection.
- **Frequency marker:** for measuring frequency differences.
- **Dial frequency Accuracy:** ±1.0%
- **Nominal Sensitivity:** —50 dbm for entire frequency range.

MULTI-PULSE SPECTRUM SELECTOR





Model SD-I

Permits spectrum analysis of individual microwave pulses in a pulse group when used with any Polarad Spectrum Analyzer. Any pulse in a complex coded signal may be isolated for examination.

POLARAD ELECTRONICS CORPORATION

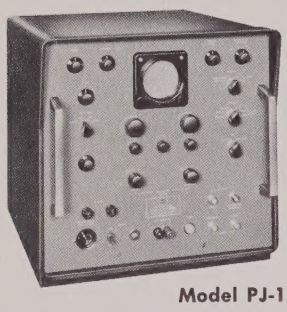
33-10 Queens Boulevard, Long Island City 1, New York

FREE LIFETIME SERVICE

POLARAD
PROVEN RELIABILITY

A GUIDE TO MICROWAVE ELECTRONIC TEST INSTRUMENTS

MICROWAVE LABORATORY EQUIPMENT



Model PJ-1

PULSE JITTER TESTER

Measures

Relative jitter: 5, 10 and 100 nanoseconds full scale

Pulse width jitter: 5, 10 and 100 millimicroseconds full scale

Repetition rate jitter: 5, 10 and 100 millimicroseconds and 1, 10 and 100 microseconds full scale

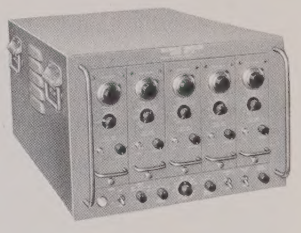
Displays: Jitter magnitude and Jitter waveform

CODED MULTI-PULSE GENERATOR

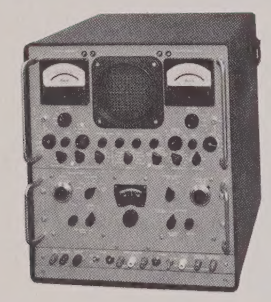
Provides up to five independently adjustable pulse channels for generation of precise coded multi-pulse trains. Each pulse can be independently pulse-time modulated by means of an external signal.

Modulation:

Group repetition rate, 10-10,000 cps
Individual pulses, in group:
Width: 0.2 to 2 μ sec.
Delay: 0 to 300 μ sec. in two steps
Provision for pulse-time modulation



Model MP-1A



Model SV-1

SERVO-ANALYZER

Combines a precision multiple signal generator and oscilloscope. Feeds a modulated reference test signal through a servo, computer or other system circuit, and compares the response on a calibrated CRT scope. Tests amplitude, phase and transient response, response of magnetic and servo amplifiers, all AC and DC servo systems. Signal generator and oscilloscope may operate independently.

Frequency Range: .001 to 100 cps in 5 ranges.

PRECISION NOISE GENERATOR

1,000 cps to 500 mc — 1 to 20 db

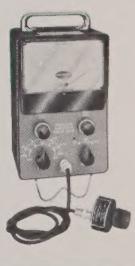
Provides stable, accurate noise output to measure directly the noise figure of vacuum-tube and transistor amplifiers and receivers in the 1,000 cps to 500 mc range.
Dial Calibration: Noise figure indicated directly in db
Accuracy: $\pm$0.25 db

Model N-1

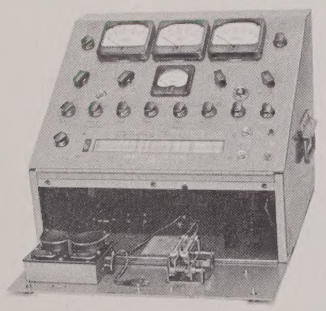
TRANSISTORIZED MICROWAVE POWER METER

Model P-3

10 to 40,000 mc



Measures absolute r-f power instantly. Line or internal battery operated. Rugged, weighs only 6 pounds. Five interchangeable thermistor mounts cover the frequency range. Direct readings in milliwatts or dbm. High sensitivity allows 0.01 milliwatt full-scale deflection; other ranges, up to 10 milliwatts full scale.



Model K-200

MICROWAVE TUBE TESTER

Tests both internal cavity and external cavity klystron tubes, pencil triodes, rocket tubes and lighthouse tubes. Operates as simply as conventional tube testers. Monitors cathode, anode, grid and reflector voltages and currents. Tests for shorts and filament continuity.

ALL-CERAMIC REFLEX KLYSTRON TUBES

Polarad Tube Type	Frequency Range
ZV 1012	500 to 3,000 mc
ZV 1010	700 to 3,000 mc
ZV 1010X	950 to 2,800 mc
ZV 1021X	1,000 to 4,000 mc
ZV 1009	1,500 to 6,000 mc
ZV 1009X	1,700 to 5,000 mc
ZV 1011	4,000 to 11,000 mc

X Series Klystrons have 200 mw minimum output.

Maximum shock, vibration and heat resistance. Guaranteed for operation up to 250°C; no cooling required. Low noise, stable and low microphonic operation.

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 18, Long Island City 1, N.Y.

POLARAD ELECTRONICS CORP.
33-10 QUEENS BOULEVARD,
LONG ISLAND CITY 1, N. Y.

MAIL THIS CARD for specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements."

FREE LIFETIME SERVICE

POLARAD
ELECTRONICS CORPORATION
33-10 Queens Boulevard, Long Island City 1, N. Y.

THESE ARE POLARAD REPRESENTATIVES IN THE UNITED STATES AND THROUGHOUT THE WORLD

DOMESTIC REPRESENTATIVES

ARIZONA
CALIFORNIA
NEVADA

T. Louis Snitzer Company
5354 W. Pico Blvd.
Los Angeles, Calif.
Webster 8-2074

T. Louis Snitzer Company
7814 Ivanhoe Ave.
La Jolla, Calif.
Glencourt 4-2191

T. Loius Snitzer Company
510 S. Mathilda Avenue
Sunnyvale, Calif.
Regent 6-6733

ARKANSAS
LOUISIANA
OKLAHOMA
TEXAS
NEW MEXICO

Industrial Associated Electronics
2311 Farrington
P.O. Box 10876
Dallas, Texas
Riverside 8-0780

Industrial Associated Electronics
Room 2018
International Airport Terminal
El Paso, Texas
Prospect 2-2441

ILLINOIS
INDIANA
WISCONSIN

Loren F. Green & Associates
5218 West Diversey Avenue
Chicago, Illinois
Palisades 5-6824

OHIO
WESTERN PA.
MICHIGAN

Harvey Teplitz & Co.
3718 Salem Avenue
Dayton 6, Ohio
Crestview 7-9178

Harvey Teplitz & Co.
671 Sycamore Drive
Cleveland, Ohio
Redwood 1-5676

Harvey Teplitz & Co.
19942 Inkster Road
Detroit 19, Michigan
Kenwood 7-9058

ALABAMA
FLORIDA
GEORGIA
MISSISSIPPI
N. CAROLINA
S. CAROLINA
TENNESSEE

Murphy and Cota
2110 Peachtree Road, N.W.
Atlanta 5, Ga.
Trinity 6-3020

Murphy and Cota
1106 Burke Street
Winston-Salem, N.C.
Park 4-0750

Murphy and Cota
2319 E. South Street
Orlando, Fla.
Garden 4-2167

Murphy and Cota
250 Governors Drive
Huntsville, Ala.
Jefferson 6-9121

NEW ENGLAND

George Gregory Associates
7 Erie Drive
Natick, Mass.
Olympic 5-1330

George Gregory Associates
9 South Street
Chesire, Conn.
Broning 2-5040

MISSOURI
KANSAS
IOWA
NEBRASKA

Engineering Services Co.
4550 Main Street
Kansas City 11, Mo.
Pi-3-7227 1-7765

Engineering Services Co.
6717 Vernon Avenue
St. Louis, Mo.
Parkway 6-2233

Engineering Services Co.
247 South Pinecrest
Wichita, Kansas
Murray 3-3751

Engineering Services Co.
106 29th Street N.E.
Cedar Rapids, Iowa
Empire 5-6183

METROPOLITAN
NEW YORK CITY

Home Office
Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, N.Y.
Exeter 2-4500
Joe P. Schindler
Alfred A. Goldberg
Richard J. Sheloff
Robert E. Savold

VIRGINIA
WASHINGTON, D.C.
WEST VIRGINIA

Brimberg Associates
1343 H. Street N.W.
Washington 5, D.C.
Decatur 2-8000

MARYLAND
SOUTH NEW JERSEY
EASTERN PENNSYLVANIA

Eastern Instrumentation, Inc.
613 West Cheltenham Avenue
Philadelphia 26, Pa.
Waverly 7-6269

Eastern Instrumentation, Inc.
808 Ingleside Avenue
Baltimore 28, Md.
Ridgeway 4-3676

Eastern Instrumentation, Inc.
8616 Georgia Avenue
Silver Springs, Md.
Juniper 9-0100

NEW YORK STATE
(EXCEPT METROPOLITAN
NEW YORK)

Naco Electronics
119 Luther Avenue
Liverpool, N.Y.
GR 4-7481

Naco Electronics
74 Park Avenue
Rochester, N.Y.
Greenfield 3-4169

Naco Electronics
Stanley Theater Bldg.
261 Genesee Street
Utica, N.Y.
Redwood 2-3151

COLORADO
UTAH
WYOMING
MONTANA

McLoud & Raymond
2151 South Grape Street
Denver 22, Colorado
Skyline 6-1589

McLoud & Raymond
P.O. Box FG-146
Salt Lake City, Utah

OREGON
WASHINGTON
IDAHO

Hawthorne Electronics
700 S.E. Hawthorne Blvd.
Portland, Oregon
Belmont 4-9375

Hawthorne Electronics
Room 112 Administration Bldg.
Boeing Field
Seattle, Washington
Parkway 5-1406

DOMINION
OF
CANADA

Measurement Engineering Ltd.
P.O. Box 1352
Station O
Montreal, Quebec, Canada
National 7-4313

Mel Sales Ltd.
71 Crockford Blvd.
Scarborough, Toronto

Mel Sales Ltd.
Arnprior, Ontario
Canada

OVERSEAS REPRESENTATIVES

ARGENTINA

Tecnitron
Charcas 1337
Buenos Aires

AUSTRALIA

Electronic Industries
Imports Pty Ltd.
139/143 Bouverie St.
Carlton, N. 3, Melbourne

AUSTRIA

INGLOMARK
Markowitsch & Co.
Mariahilfer Str 133
Vienna XV

BENELUX
I.R.C.A.
Paradysstraat 92
Voorburg

BRAZIL

Emile H. Staub, S.A.
Caixa Postal 4612
Sao Paulo

CHILE

Fred Muller, SAC.
Casilla Coreo 3844
Santiago

CHINA

Heighton Scientific Co.,Ltd.
49, South Yen-Ping Road
Taipei, Taiwan

DENMARK

Ditz Schweitzer
Bredgade 37
Copenhagen

ENGLAND

Allied International Co., Ltd.
4, Tilney Street Park Lane
London W. 1

FINLAND

Orbis O/y
P.O. Box 2165
Helsinki — Toolo

FRANCE

Bureau de Liaison
113 Rue de L'Universite
Paris 7e

GERMANY

Rohde & Schwarz Vertriebs GMbH
Zweigniederlassung
Hohe Strasse 160-168
Koln

GREECE

Ev. D. Devletoglou
44 Eleftheriou Venizelou
Athens

ICELAND

Elding Trading Company
Hasnarhvoli
Reykjavik

INDIA

B. N. Bose & Company
1st Floor, 8 Waterloo St.
Calcutta—1

ISRAEL

Electronic Equipment
6, Ibn Gvirol
Tel-Aviv

ITALY

Bay & C.S.P.A.
Via Fabio Filzi N. 24
Milano (506)

JAPAN

Marubun Co., Ltd.
No. 1, 2-Chome
Odenmacho, Nihonbashi
Chuo-Ku, Tokyo

MEXICO

Standard Electrica de Mexico, S.A.
Calle Madrid 21-F
Mexico 4, D. F.

NEW ZEALAND

W & K McLean, Ltd.
7 Anzac Avenue
Auckland

NORWAY

P. N. Biorn
Tollbodat. 4
Oslo

PERU

V. M. LaPierre & Cia.
Los Alamos 375
San Isidro, Lima

PHILIPPINES

Radio Electronic Headquarters, Inc.
P.O. Box 1400
Manila

PORTUGAL

Equipamentos de
Laboratoria, Lda.
Apartado 458
Lisbon

SOUTH AFRICA

Leigh & Hurwitz (Pty) Ltd.
P.O. Box 3236
Johannesburg

SPAIN

Rema Leo Haag
Pla de Sto Domingo 1
Madrid

SWEDEN

Electronikbolaget AB
Barangsgatan 30
Stockholm SO

SWITZERLAND

Omni Ray AG
Dufourstr 56
Zurich 8

Manufacturers of Microwave & Electronic Equipment